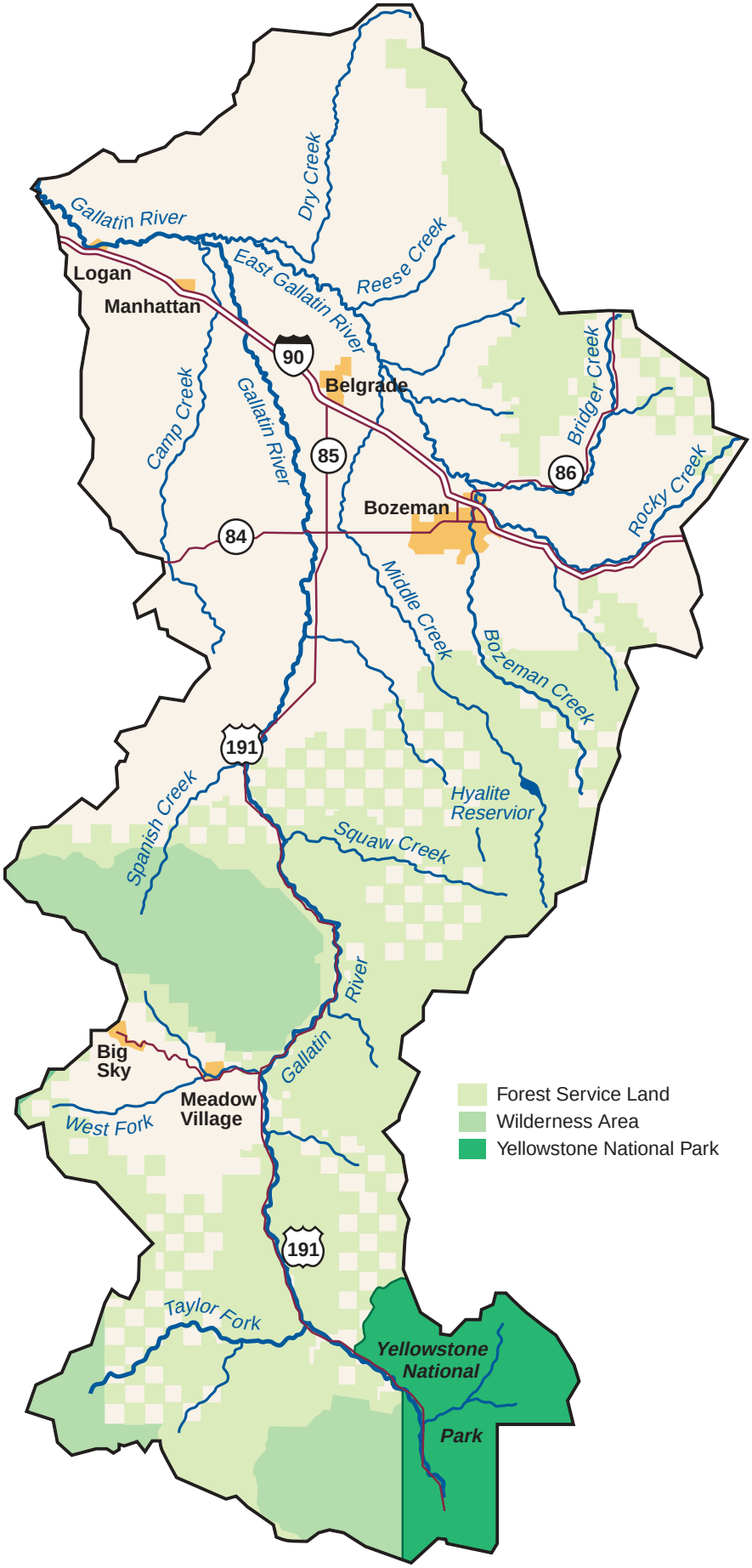
The Gallatin Watershed Sourcebook: A Resident's Guide

Bridger Outdoor Science School
Bureau of Reclamation
Great Plains Region
Gallatin Local Water Quality District
Montana Watercourse
United States Department of Agriculture
Natural Resources Conservation Service

Welcome to the Gallatin. The Gallatin Watershed encompasses some 1,800 square miles.



The Gallatin Watershed Sourcebook: A Resident's Guide

A Reference Guide to Water Resources in the Gallatin Valley

Contents

Agency Acronyms Used in this Guide:

DNRC - Montana Department of Natural Resources and Conservation
EPA - U.S. Environmental Protection Agency
MCA - Montana Code Annotated
MDEQ - Montana Department of Environmental Quality
MFWP - Montana Fish, Wildlife and Parks
MSU - Montana State University
NRCS - U.S. Department of Agriculture, Natural Resources Conservation Service
USDA - U.S. Department of Agriculture
USGS - U.S. Geological Survey
USFWS - U.S. Fish and Wildlife Service

Common Measures:

1 cfs (cubic foot per second) = 7.48 gallons/second
= 448.8 gallons/minute
= 40 miner's inches
= 646,272 gallons/day
= 1.98 acre-feet/day

1 acre-foot = volume of water that covers an acre to a depth of 1 foot
= 43,560 cubic feet
= 325,851 gallons
= supplies a family of 5 for 1 year

CHAPTER 1 You Live in a Very Special Place

A Land Carved From Water

From its origins on the Yellowstone Plateau, the roof of the North American continent, the Gallatin River splits the twin ranges of the Madison and Gallatin. Descending in a torrent that the Shoshone called "Cut-tuh-o'-gwa" (swift water), the river slices through a canyon rimmed by the fossil remains of a lush tropical valley that existed some 50 million years ago. At the canyon's mouth, where the river still cuts at the canyon floor, the river bursts into a broad "new" valley. The thin veneer of gravel covering the valley was transported by water and glaciers, like the glaciers that sheared away rock to create high mountain parks, such as Hyalite meadows in the southern Gallatin Range. The valley is bounded to the west by the Horseshoe Hills, ancient mountains filled with the fossils of trilobites, and to the east by the Bridger Mountains, a steep fold of younger sedimentary rock.

Photo: James Healy

Formed by ancient seas and the action of frozen and moving water, the valley continues to be shaped by the Gallatin and its tributaries today. In an average year, the Gallatin's rivers and streams carry enough water to cover 1,200 square miles, an area the size of Rhode Island, a foot deep in water. Numerous springs are supported from abundant groundwater sources. This water supports lush, water-loving vegetation, which in turn sustains vigorous populations of fish and wildlife.

Abundant wildlife in and along the Gallatin first attracted prehistoric North American people to the region. Later, Blackfeet, Crow, Bannock, Nez Perce, and Shoshone Indians hunted and fought in the valley. In 1806 William Clark, one of the first white men to travel up the Gallatin, wrote:

> *"a butiful navigable stream. Saw a large Gangue of Elk in the plains and Deer in the river bottoms...I saw several Antelope, common Deer, wolves, beaver, otter, Eagles, hawks, crows, wild gees, does, etc, etc....emence quantities of beaver... I proceeded on about two miles crossing those different channels all of which were dammed with beaver in such a manner as to render the passage impracticable... being swamped as I may say in this bottom of beaver."*

Yesterday's Promise

Later settlers to the Gallatin Valley not only had to cope with the challenges of removing the abundance of water described by Clark, but also with bringing water to the higher fertile ground. The first diversion of water in the valley is credited to the Penwell brothers northeast of Belgrade in 1864. In 1871, in what is regarded as one of the first mutual ditch-building efforts in Montana, settlers of the Middle Creek area formed the Upper Middle Creek Ditch Company. Other for-profit companies entered the water supply arena in the 1880s and 1890s, building the Farmers Canal and the High Line Canal, which served ranches on both sides of the main stem of the Gallatin. The last large-scale effort to supply agricultural water to the valley was the construction of the Hyalite Reservoir, completed in 1950. Today, the Gallatin River is the source of irrigation water for about three fourths of the irrigated land in the valley.

The Gallatin River has seen other use in the service of industry. At the turn of the century, tie cutters working out of the Taylor's Fork gathered their logs behind retaining dams. The dams were broken in the spring, floating the logs on a flood of water to mills at Central Park, near Manhattan. This practice was discontinued by 1907. A scheme to dredge mine the Gallatin from West Fork to the Yellowstone Park boundary failed through

lack of investment in 1917. Proposals to dam the Gallatin surfaced periodically beginning in the 1930s. The most serious of these proposals was to dam the river at the mouth of Spanish Creek. Strong opposition from recreational interests in the 1950s laid to rest the issue of building a dam on the river. Nonetheless, development of a different kind continues in the canyon and its reaches today.

Photo courtesy of Gallatin County Historical Society

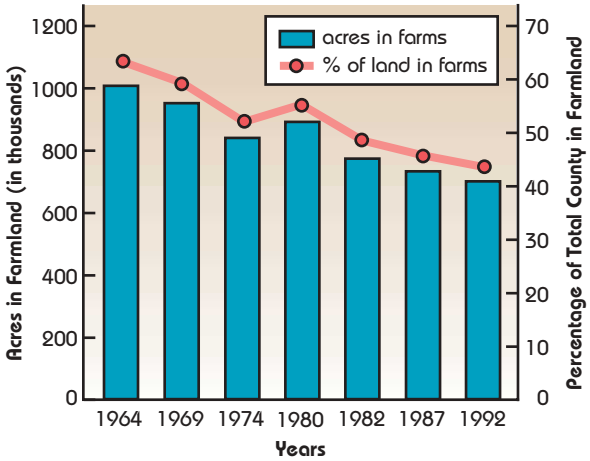
Log drive on the Gallatin, ca. 1910.

Today's Challenge

In 1864, W. Alderson described the Gallatin Valley as "one of the most beautiful and picturesque valleys the eye ever beheld, abounding in springs of clear water." Others in the late 1800s echoed these sentiments, calling it "The Egypt," or "The Garden Spot of Montana." For the most part, these descriptions are fitting today. The valley is still fertile and, in spots, even lush. The water supplying this Eden with its life force is no less appreciated today than in former times. Abundant, renewable water from the Gallatin and its tributaries shapes every aspect of our daily lives, whether it is used for farming, ranching, recreation, or household use.

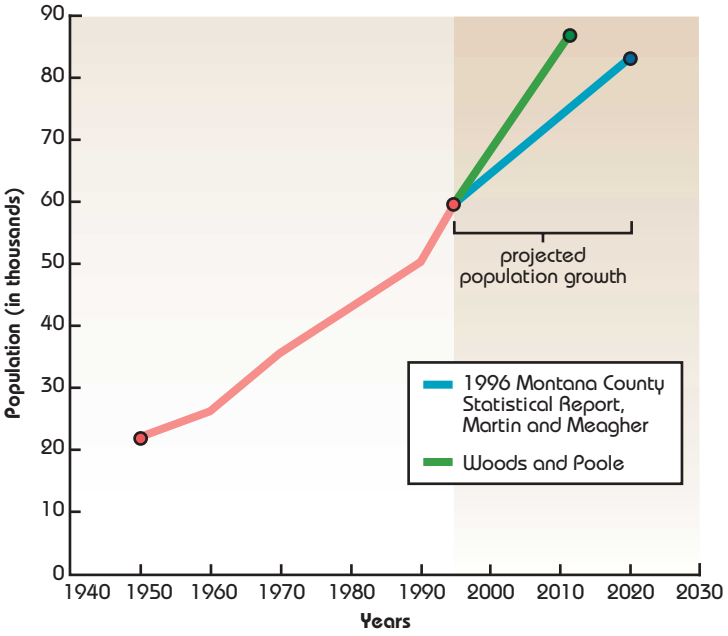
Today's challenges for the watershed spring from a multitude of causes. Most notably, rapid and unprecedented growth of residential development is placing increasing demands on our surface and groundwater resources. Population growth in Gallatin County from 1990 to 1997 was 21 percent, or 3 percent per year. Changes in population put new demands on both the quality and quantity of water in the Gallatin Watershed. A growing Gallatin Watershed also means changing land use. As fewer acres remain in farmland, the watershed faces new challenges. Protection of the watershed, both surface and subsurface waters, is critical if we are to have the healthy environment that sustainable communities in the Gallatin Valley require.

Ultimately, the well-being of the Gallatin and its tributaries will depend on people who care enough to become informed, become involved, and make the investment of time and energy to ensure that our water resources are protected. This Sourcebook is your guide to finding where you can make your contribution to sustaining water resources in the Gallatin Watershed.



Source: Montana Department of Commerce 1997, Montana Statistical Abstracts.

Changing land use will affect the quality and use of water in the Gallatin.



Sources: Martin and Meagher, 1996 Montana County Statistical Report. Woods and Poole Economics, Inc. 1998, Data Pamphlet, Gallatin County, Montana.

Actual and projected population growth in Gallatin County, 1950-2010.

CHAPTER 2. The Gallatin Watershed

What is the Gallatin Watershed?

Chances are that wherever you live in the Gallatin Valley, a stream, river, or irrigation ditch is less than a few hundred feet from your door. This abundance of free-flowing water gives the Gallatin Valley its unique character. A "watershed" includes the land that water flows over or under from its highest points on hilltops and mountains to its lowest points along streams, rivers or lakes. The Gallatin Watershed is composed of the streams and underground water that flows to the Gallatin River. Nested within the Gallatin Watershed are the smaller watersheds of its tributaries, such as the Taylor Fork Watershed and the Bozeman Creek Watershed. How each of us uses the soil, water, plants, and animals within the watershed affects what happens not only in our watershed but also in larger watersheds downstream. We are all part of the Gallatin Watershed community.

Sources of Water

The primary source of water for streams, springs, and wetlands in the Gallatin Watershed comes in the form of mountain snowpack. The headwaters of the watershed, in the Gallatin and Madison Ranges, receive nearly 300 inches per year of snow on average. This equals approximately 50 inches of rain. In contrast, the lower watershed at Logan may receive fewer than 12 inches of rain per year—a near desert by comparison.

Geology and Soils

The main stem of the Gallatin River originates in the Madison and Gallatin Ranges. These mountains are composed primarily of "basement rocks" of gneiss and schist, covered in places by a thin layer of rocks formed from the sediments that sank to the bottom of an ancient shallow sea that covered Montana from 570 to 65 million years ago. The East Gallatin originates in the Bridger Range, which is also comprised of basement rocks overlain by younger sedimentary formations. Where the streams leave the mountains, the valley widens into a large basin filled with sediments, some more than 6,000 feet deep east of Bozeman Hot Springs. These sediments, laid down during the Tertiary period (from 65 to 2.5 million years ago), vary in type, but are mostly rocks made from sand and silt. On top of these sediments are up to 150 feet of gravel, sand, silt, and clay washed from streams. These deposits are called alluvium. More recent alluvial deposits compose the next and last layer of fill, which covers half the valley. These deposits extend in large fans

A Cross-Section of the Gallatin Watershed

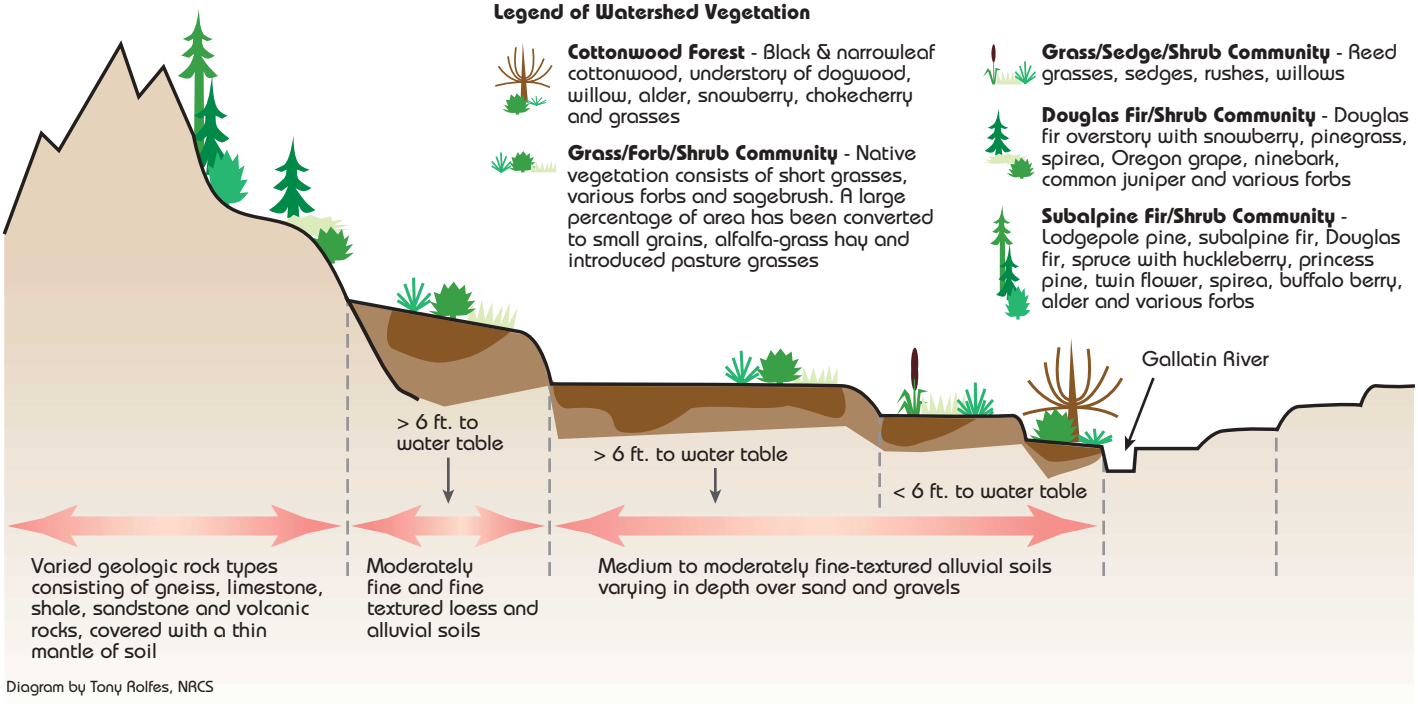
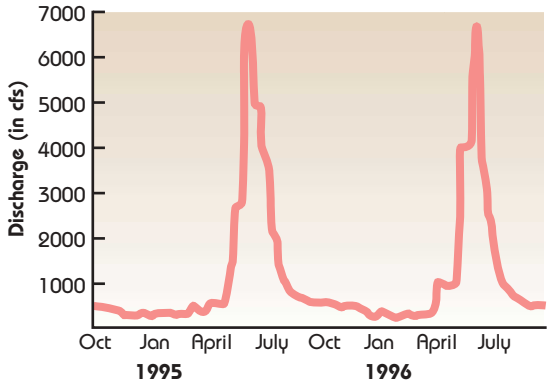


Diagram by Tony Rolfes, NRCS

from the source streams where they break out of the mountains. The largest fan is at the base of the Gallatin Range south of Bozeman. This very recent or Quaternary alluvium is mostly comprised of pebbles and gravel. Its thickness ranges from 70 feet at Bozeman Hot Springs to 800 feet near Belgrade. The Quaternary alluvium that covers most of the central valley is important, because it is some of the most permeable material in the valley and the most reliable source of groundwater.

Soils in the watershed are a product of the rocks that form them. Coarse-textured rocks like gneiss, schist, and sandstone typically form gravelly and sandy soils, while sedimentary rocks like shale and limestone form clayey soils. Much of the stream sediment carried in the spring runoff comes from areas of fine-textured rocks and clay-rich soils. Many landslides and earthflows in the watershed are associated with fine-textured soils, and contribute high amounts of sediment to the Gallatin watershed. In contrast, soils formed from coarse-textured rocks usually allow passage of water at a high rate and are highly erodible. Valley soils are usually formed from either fine-textured sediments, wind-blown silt deposits, or stream alluvial deposits. Many soils in the central valley are saturated with water for much of the growing season. These "hydric" soils, unless drained, favor the kinds of water-loving plants that grow under conditions of reduced oxygen. Depending on where you live, management concerns may include high water tables, unstable or erosive stream banks, or shallow depths to sand and gravel, all of which can affect waters in the Gallatin Watershed.



Source: USGS

A "hydrograph" shows changes in annual flows, here for the Gallatin River near Gallatin Gateway.

Hydrology of the Watershed

Surface water

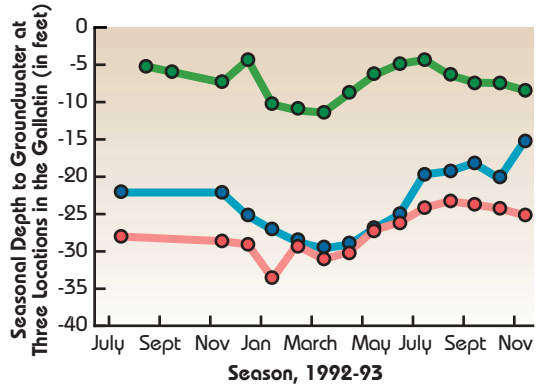
Water held as snowpack in the Gallatin and Madison Ranges typically contributes to peak flows in lower watershed streams and rivers in May and June. While this is also true of streams from the Bridger Mountains, a higher percentage of runoff from the Gallatin and Madison Ranges occurs later in the summer than from Bridger Mountain streams. Because of the higher snowpack, these streams are more reliable sources for late-summer irrigation. Of the total annual yield of water from the tributaries of the Gallatin, about 14 percent comes from streams originating in the Bridger Mountains (Rocky, Bridger, Middle, Cottonwood, Reese, and Dry Creeks); 14 percent comes from streams originating in the north Gallatin Range (Hyalite, Sourdough, Story, South Cottonwood, and Big Bear Creeks); 11 percent comes from tributaries of the north Madison Range (Spanish, Hell Roaring, and Fish Creeks); and the rest (61 percent) comes from the South Gallatin and Madison Ranges.

Real-time hydrographs for the Gallatin River are available from the World Wide Web at http://water.usgs.gov/public/realtime.html. Data from 56 other gauging stations in the watershed are available at http://waterdata.usgs.gov/nwis-w/MT/

Water resource maps are available from the Natural Resources Inventory System, Montana State Library at http://nris.mt.gov/wis

Groundwater

Groundwater is an important source of water for drinking and irrigation in the Gallatin Valley. Valley fill deposits are the primary aquifer from which most of the domestic ground water drinking water supply is drawn. About 2,500 acres of the watershed are irrigated with groundwater. Groundwater flow in the valley is generally from the east and southeast to the northwest, where the Gallatin River exits the valley at Logan. Depth to groundwater varies from as close to the surface as 3 feet in the central valley to 460 feet in the Camp Creek Hills. Groundwater depth is greatly influenced by irrigation practices. In years when less irrigation water is used, depth to groundwater drops in areas traditionally irrigated and rises in areas where irrigation is not practiced. Flood irrigation and leaky ditches can contribute to higher water tables during the growing season, after spring runoff has occurred. Groundwater depth fluctuates seasonally as well, with the lowest depths occurring in January and February. Periods when groundwater recharge occurs coincide with peak flows from surface water.



Source: Slagle 1995

Depth to groundwater can vary throughout the season.

CHAPTER 3

Plumbing the Gallatin: Water Supply and Distribution

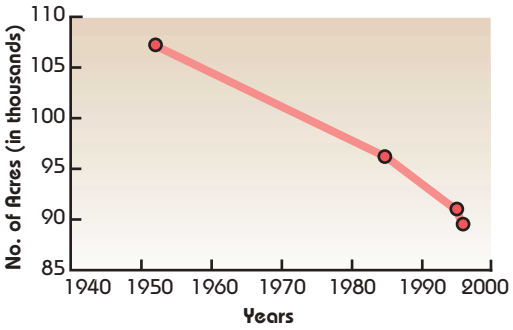
–Scott Compton, DNRC

The Gallatin's landscape is a product not only of its great natural streams and springs, but also a result of the intricate network of water diverted, pumped and channeled around the valley. The "engineered watershed" determines to a large part where people can live and which land is most productive.

Photo: H. Corry, NRCS

Man-made watershed feature.

Irrigated Acreage in Gallatin County 1952-1996



Source: Slagle 1995; USDA Montana Agricultural Statistics 1997

Irrigated acreage in the Gallatin decreased from about 107,261 acres in 1952 to 89,600 acres in 1996.

Public Water Systems

The largest system supplying water for household and commercial use in the Gallatin is the Bozeman system. This system supplies slightly less than half of the people (about 26,000 in 1998) living in the watershed. Bozeman draws water from three sources: Bozeman Creek, Hyalite Creek (and Hyalite Reservoir), and Lyman Creek. The water from Bozeman and Hyalite Creeks is piped to a water treatment plant south of Bozeman. The Lyman Creek supply consists of a spring box water collection system supplying Lyman Creek Reservoir, located northeast of Bozeman. The quality of water from Lyman Creek is such that it receives only chlorination and fluoridation. The water is delivered to three water storage reservoirs (Sourdough, Hilltop, and Lyman Creek) and is supplied to the distribution system through two principal transmission systems. The distribution system consists of approximately 120 miles of water mains, ranging from 4 to 24 inches in diameter.

Bozeman, like many cities, has two separate urban drainage systems. The water that is used in homes is carried away by sanitary sewers and treated before being discharged to the East Gallatin. The normal low flow of this system is about 3 million gallons/day, with a current capacity of around 5.78 million gallons/day. Bozeman's wastewater treatment plant is a "tertiary" treatment facility, meaning that advanced processes are used to effect greater removal of pollutants. An entirely separate system, the storm sewer, handles snow and rain runoff from streets. Most of this water is carried to detention ponds to settle prior to discharge to ditches and streams, but some older lines flow directly into creeks and ditches flowing to the East Gallatin.

Belgrade is supplied by groundwater. Four wells yield approximately 4.3 million gallons/day, serving approximately 5,400 people. Stormwater is released to the soil through percolation from a system of drains. Belgrade's sanitary sewage is settled in storage lagoons, aerated, and clarified, but does not receive advanced waste treatment. This is known as "secondary" treatment. Unlike Bozeman, Belgrade wastewater is not discharged to a river. Residue is disposed of on land.

Manhattan, by comparison, receives its supply through both wells and a spring. Manhattan is permitted to discharge treated sewage into the Gallatin River.

Big Sky differs only from the city systems in that it is run as a county water and sewer district. Wells at the mountain ski area and at the Meadow Village supply approximately 800,000 gallons/day, serving some 2,400 single family homes. This involves about 6,000 people at peak use. A small stormwater system collects runoff from the mountain mall. Sewage is treated, stored, and land-disposed by spraying.

Get more facts about the Gallatin at the Environmental Protection Agency "Surf your Watershed" web site, http://www.epa.gov/surf/IWI/10020008.

Private Domestic Water Sources

There are approximately 30 other "community" water systems that together supply domestic water to some 4,000 people in the watershed. Community wells are centralized private well systems that connect to

Bozeman Water Rights

	Annual Volume (legal allocation)		Annual Volume (reliable yield)[1]	
Source	(ac-ft)	(MGY)*	(ac-ft)	(MGY)
Sourdough Creek**	4,764	1,552	3.734	1,217
Middle Creek***	1,970	641	1,526	497
Lyman Creek	4,307	1,406	1,280	417
Hyalite Reservoir	5,319	1,733	4,255	1,386
TOTAL	16,360	5,332	10,795	3,517

* Million gallons per year
** Also referred to as Bozeman Creek
*** Also referred to as Hyalite Creek
[1] Reliable yield = the amount of flow actually available given natural fluctuations and other existing rights
Source: MSE-HKM Engineering, Bozeman Water Facility Plan

multiple users, some with as many as 400 users. All of these systems are supplied by groundwater. Individual wells supply domestic water for almost all rural households. As of March 1998, there were 9,500 wells on record in the watershed, of which approximately 75 percent had filed water rights.

Major Diversions from the Gallatin River

	Irrigated Acres	Cfs Diverted
Farmers' Canal	11,000	250
Lowline Canal	9,500	188
High Line Canal	12,000	170
West Gallatin Canal	8,000	150
Moreland Canal	1,600	125
Middle Creek Supply	5,300	122

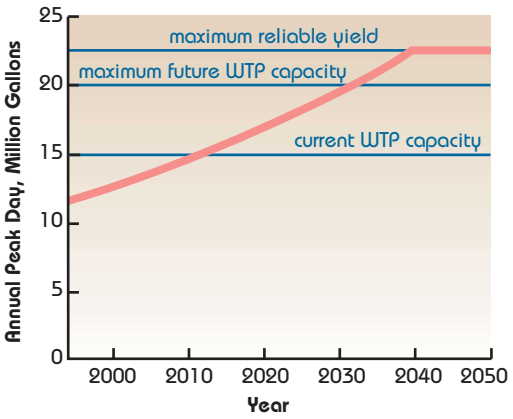
Source: DNRC

Irrigation

Many canals and ditches crisscross the valley, delivering water for irrigation. Of the water taken from the main stem of the Gallatin, most is diverted between the mouth of the canyon and Four Corners. These diversions have water rights that essentially capture the entire flow of the river until return flows recharge the lower Gallatin below Four Corners. However, cooperation between the court-appointed Water Commissioner and irrigators has prevented the river from being totally dewatered in the past.

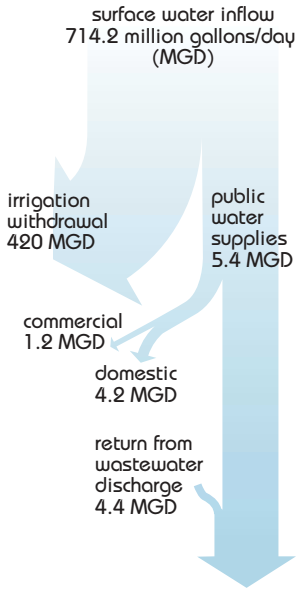
In the Gallatin, most canals and ditches are privately owned and managed by local irrigators. One exception is the Middle Creek Water Users' Association, a non-profit corporation that manages some storage rights to Hyalite Reservoir, a state-owned project.

Projected Annual Water Use for Bozeman



Source: MSE-HKM Engineering

Annualized Daily Water Budget for the Gallatin



Source: USGS

Reservoirs

There are approximately 130 reservoirs in the watershed, the largest being Hyalite Reservoir, which stores some 10,100 acre-feet of water. Most small reservoirs in the Gallatin have a recreation/fishing aspect to their use. Pond construction for recreation and aesthetic purposes by private landowners with access to water is increasing.

Water Supply

Overall, water supplies in the Gallatin are good. Large quantities of groundwater exist in the central valley, although some foothills areas have experienced declines in groundwater level at times. The latter is likely due to poor recharge of local groundwater sources. Despite conversion of many areas in the valley from agricultural land to subdivisions, depth to groundwater has not changed significantly from 1950 to the present. Increased depth to groundwater would be indicative of depletion of the aquifer.

Surface-water supply depends on the yearly snowpack and rainfall. Low water years may cause water rights to be cut off sooner than usual and affect some crop production. On the other hand, Hyalite Reservoir is, statewide, one of the DNRC's most consistent suppliers of water.

While supplies of water are physically available in the Gallatin, new rights for consumptive purposes are not legally available. The Gallatin is one of several rivers in the upper Missouri Basin closed to new withdrawals (see Chapter 4).

Water for the Next Century

As the valley's population increases, the question of how to quench its growing thirst looms larger. Growing Bozeman will reach several milestones in the next few decades, as it exceeds the existing capacity of its water treatment and distribution infrastructure and, ultimately, the maximum reliable yield of its current water supply. Absent a change in efficiency or conservation measures, Bozeman will exceed its current water supplies by 2042. Bozeman continues to look into acquiring direct flow rights as they become available, and the city is examining the feasibility of rebuilding a reservoir in the Bozeman Creek watershed that was breached in the 1980s. Conservation of water will no doubt play a role in determining Bozeman's water supply future, as will education, regulation, and changing rate structures.

While groundwater appears to be plentiful in most areas, changes in land use may affect irrigation practices. Water losses from conveyance ditches have a major effect on recharge of the valley's aquifer. As subdivisions replace flood-irrigated fields, local water tables could drop in some areas and rise in others. The biggest threat growth may pose to groundwater is the contamination from individual septic systems in high-density developments and from localized chemical spills.

Information:

Groundwater Information Center, Montana Tech, Butte (406) 496-4336

DNRC Bozeman Regional Office 586-3136

US Geological Survey, Helena (406) 441-1319

City of Bozeman, *Water Facility Plan for Bozeman, Montana,* MSE-HKM Engineering, Nov. 1997 582-2300

CHAPTER 4 Water Rights

Prior Appropriation

European settlers arriving in the country west of the Mississippi encountered fertile lands but an arid environment that did not always provide enough rain to reliably produce crops. Diversion of water for irrigation was an early necessity, but water resources were limited. The demands for water often could not be met for all potential users on a stream. Borrowing from rules worked out in mining camps that established rights to divert water to wash ore, most western states, Montana included, adopted the Doctrine of Prior Appropriation. This doctrine, more commonly known as "first in time, first in right," determines how water in a stream is to be allocated among the potential users of the water. The doctrine gives the priority right to divert water from a stream or river for a "beneficial use" to the person ("appropriator") who first puts the water to use. The doctrine is used to settle disputes that typically arise in low-flow years, when more than one appropriator wishes to use the same limited supply of water.

In 1973 Montana passed the Water Use Act, which reformed the historical water rights process. This act adopted a central records system, a new permitting process to acquire water rights, and a process to resolve disputes about claims to water. In 1979, the law was amended to create a Water Court to "adjudicate" (finalize) claims for water use in the state. For administrative purposes, the state has been divided into 85 "basins," which reflect the boundaries of the watersheds involved. The DNRC manages the records system and all filing for water rights since 1973. A temporary preliminary decree was issued for the Gallatin River watershed (Basin 41H) in 1985 and the DNRC is currently going through the process of finalizing all the claims. Approximately 5,750 claims have been filed for existing rights in the Gallatin Watershed.

Resolving Water Rights Disputes

1. **Talk with the person causing the water problem.**
2. **If a person is wasting water, using water unlawfully, or preventing water from moving to another person having a prior right to use the water, notify the DNRC (MCA 85-2-114).**
3. **If the water right is subject to a previous decree, file a petition to appoint a water commissioner (MCA 85-5-101).**
4. **Fifteen percent of owners of water rights on a stream may petition the court to appoint a water mediator (MCA 85-5-110).**

Acquiring and Transferring Water Rights

A permit is required before diverting, withdrawing, impounding, or distributing any surface water [or groundwater at rates of 35 gallons per minute (10 acre-feet) or more]. Groundwater uses for less than these amounts also require permits, but this is a simpler process done after the water is put to use. Currently, the upper Missouri Basin, including the Gallatin Watershed, is temporarily closed to any new withdrawals of surface water for consumptive use (but not municipal, domestic, or livestock use). This action is due in part to large power-generation rights downstream. When land is sold or exchanged, title to existing rights is passed from the original appropriator to subsequent purchasers of the land benefited by the diverted water. The DNRC Regional Office should be consulted before transferring any water right claims. Beginning in 1998, any party transferring property in Montana will be required to file a signed water rights disclosure to the buyer (MCA 85-2-424).

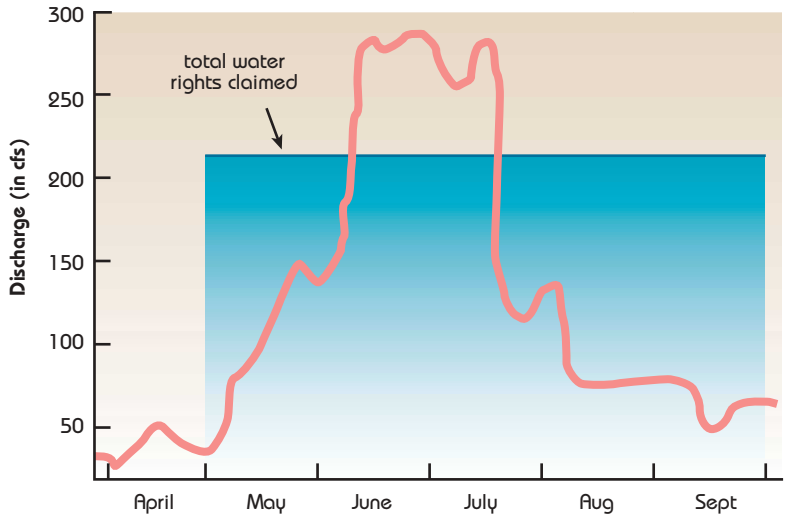
Water rights may also be leased on a limited basis for the creation of instream flow. Temporary changes in the beneficial use, as well as exchanges, are permissible following administrative review by DNRC.

Maintaining Instream Flow

We generally think of the water in our streams as linked in one unbroken chain from a spring high in the mountains to the sea. Yet diversions from many of the Gallatin Watershed's streams and the Gallatin River itself may reduce flows to a trickle in years when water is scarce. Dewatering is of considerable concern. We count on maintenance of adequate flows to dilute sediment and contaminated runoff from fields and towns, maintain cool temperatures for fish and other aquatic animals, and provide swimmable, fishable, and boatable water for recreationists.

In 1969 the Montana legislature authorized the Game and Fish Commission to file for unappropriated rights for some blue-ribbon fishing streams, including the Gallatin River, to maintain stream flows. The legislation that established these so-called "Murphy rights" was repealed in 1973, but not before a claim was made on the main stem of the Gallatin

How Water Rights Work



Source: Data from USGS, DNRC

A hydrograph shows the average annual flow on Hyalite (Middle) Creek. The total water rights claimed on the upper creek total about 215 cfs, which exceeds the flow of the river for most of the year. Junior claimants are typically cut off by early August. Remaining diversions essentially take the remaining flow for the rest of the irrigating season, resulting in some dewatering.

River. The 1973 Montana Water Use Act included a new statutory process to create reserved water rights in the state. Claims for reserved rights on the Gallatin River were also made under this new law. However, these reservations have "no force and effect" due to legislative closure of the upper Missouri Basin. "Murphy rights" are also very junior to the rights of prior appropriators. Thus the amount of protection, as well as the impact to irrigators, has been limited to date.

What is a Beneficial Use?

According to Montana law, a beneficial use of water is considered to be any use of water. These uses include domestic activities like eating, drinking, laundering, bathing, lawn watering and watering a household garden. They also include agricultural, industrial, mining, municipal, power, recreational and fish and wildlife uses.

While the law recognizes broad categories of beneficial use, water users need to be aware that wasteful use of water is not a beneficial use within the meaning of the law. More efficient use of water leaves more water in the stream for fish and wildlife, recreation and other users. Montana water law recognizes that salvaged water (water saved through efficiency or conservation) may be legally protected and used.

Can Water Rights Be Lost?

Water rights can be lost through abandonment if there is: (1) nonuse, and (2) intent to abandon. Once the adjudication process is complete, abandonment can occur if the right is not used according to its terms and conditions for a period of 10 years. Water transfers and water rights not used because the land is in a federal or state set-aside program are not considered abandoned. Also, water "salvaged" through conservation and leased to another user or to the Montana Fish, Wildlife and Parks for instream flow is not considered "abandoned" and its rights are not open to challenge by others.

What if a Ditch Crosses My Property?

Appropriators of water are permitted to divert water across the property of others. If an irrigation ditch crosses your property, the owner of the ditch not only has a right to all of the water flowing in the ditch, but a right to cross your property to maintain the ditch. These rights may take the form of easements recorded at your courthouse, or they may exist as rights acquired by historic use.

Information:

Montana Water Court - claims adjudication
586-4364
1 (800) 624-3270
(in state, toll-free)
586-4374 (FAX)

DNRC Regional Office - records
586-3136

DNRC - *Water Rights in Montana*
(406) 444-6603

Resources:

Montana Consensus Council - dispute resolution
(406) 444-2075

Permitting:

DNRC Regional Office - withdrawal permits
586-3136

CHAPTER 5 Sensitive Areas in this Special Place

Riparian areas

If you live near one of the Gallatin Watershed's streams or rivers, you have an added responsibility to care for one of Montana's most precious and limited resources. The surface waters of our state provide 98 percent of the water used for growing food and feeding livestock. Although areas adjacent to rivers and streams make up less than 5 percent of the landscape, they contain 75 percent of our state's plant and animal diversity. Moreover, activities closest to streams are more likely to have immediate effects on water quality. As stewards of the source waters for the Missouri River, we have an obligation to pass these waters on unimpaired to users downstream.

Photo: NRCS

Healthy riparian areas have a lush growth of vegetation.

Riparian areas are the green areas adjacent to rivers and streams. Healthy riparian areas usually contain a swath of lush growth of water-adapted plants. Healthy riparian areas are the key to maintaining healthy stream systems. Streamside vegetation helps stabilize streambanks (reducing siltation and stream-bank movement), helps slow water during peak flows, provides important breeding habitat and cover for wildlife, keeps water cooler in the summer for fisheries, prevents ice damage in winter, and traps and filters runoff that may contain sediment or pollutants from adjacent lands.

If you plan to engage in activities that might disturb the streambed or the adjacent riparian area, you may need permits from one or more agencies administering regulations to protect this sensitive and important area (see chart). In addition to the permits discussed, Gallatin County requires up to 100-foot setbacks from streams for residential or commercial construction for new subdivisions and other setbacks in some zoning districts in the county.

Information:

Montana Riparian and Wetland Association, Montana Forest and Conservation Experiment Station, School of Forestry, University of Montana, Missoula
(406) 243-2050

Montana Assoc. of Conservation Districts, *A Guide to Stream Permitting in Montana,* 501 N. Sanders, Helena, MT 59601
(406) 443-5711

Gallatin County Planning Office
582-3130

Resources:

NRCS - cost-share programs to create and enhance areas along streams in order to reduce stream-bank erosion
587-6929

U.S. Department of Agriculture, Farm Service Agency, Environmental Quality Incentive Program (EQIP) - cost-share programs to improve and protect natural resources; Conservation Reserve Program (CRP) - rental payments and cost-share assistance to establish long-term, resource-conserving cover on eligible land
587-6926.

MFWP, Future Fisheries Improvement Program - funds stream corridor improvements, including fencing and bank stabilization
(406) 444-2449

Gallatin Valley Land Trust - conservation easements for important biological and beneficial lands
587-8404

Montana Land Reliance - conservation easements
(406) 443-7027

The Nature Conservancy - conservation easements
(406) 443-0303

Permitting:

Activity	Permit Required
Any activity that modifies the bed or the banks of a stream	Gallatin Conservation District - Section 310 permit 587-6929
Construction within a floodplain	Gallatin County or Bozeman Floodplain Administrator - Floodplain permit 582-3130
Construction activity that will disturb more than one acre within 100 feet of a stream	DEQ - Storm Water Discharge permit (406) 444-4323
Timber harvesting practices within 50 feet of a stream	DNRC Forestry Practices Application (406) 542-4300
Activities that may cause turbidity or sedimentation of streams	DEQ - Short-term exemption from water quality standards (3A Authorization) (406) 444-2475
Any activity that will result in placement of dredge or fill material in a lake, stream, wetland or other aquatic site	U.S. Corps of Engineers - 404 permit (406) 441-1375

Floodplains

In the Gallatin, where few dams exist to alter natural flows, spring runoff typically results in flooding of valley streams and rivers. Floods have regularly occurred in the Bozeman area since 1893, and major flood events have occurred at increasing intervals to the present. In the Gallatin, particularly along the main and East Gallatin rivers, floods occur nearly every year in some areas.

The floodplain is the low-lying area adjacent to a stream or river where water spreads out when it leaves its banks. Floodplain soils are often poorly drained, due to the nearness of the water table to the surface. Floodplains result from the continuous process of deposition of material and later cutting away of the surface material over time by the river's meandering. The floodplain may be not much wider than the river's channel where banks are steep. It may extend for many hundreds of feet from the ordinary high water line in low-lying areas. Because of the deposited sediments and high water table, floodplains contain a high diversity of plants and animals.

Flooding is a natural process. Floodplains dissipate the energy of spring torrents, reducing flood damage downstream and providing recharge areas for adjacent streams. However, runoff from a watershed can be greatly influenced by the kinds of plants and soils in the watershed. Vegetated stream banks reduce the likelihood of flooding. Where overgrazing, timbering, or homesite development removes vegetation, flood events occur more often and with greater severity. Healthy floodplains are those where the activities occurring within the floodplain are benefited by or can adapt to occasional flooding, such as agriculture, recreation, and wildlife.

Floodplain management involves reducing the risk of damage to property from flooding, as well as maintaining the natural functions that floodplains provide. To this end, federal, state and local governments regulate certain activities that occur in "floodplains" (areas susceptible of being inundated by flood waters):

Federal: the Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program (NFIP). The NFIP is the only source of flood insurance in the country.

State: Montana regulates floodplains and floodways, including limitations on the following uses within the floodplain:

- requiring structures built in the floodplain to be constructed on fill to bring the lowest floor 2 feet above the 100-year flood elevation;
- and prohibiting within the "floodway" (an area that must be kept free of encroachment if a structure built there would increase the flood flow height by more than half a foot, MCA 76-5-401 et seq.):
  - residential construction;
  - structures that will cause water to be diverted, obstructed, or reduce the carrying capacity of the floodway, or cause erosion;
  - construction or storage of objects subject to flotation or movement during floods.

County: Gallatin County Subdivision Regulations prohibit residential subdivision within the floodplain.

City: Bozeman Zoning Ordinance and Bozeman Area Subdivision Regulations restrict development in the floodplain without a permit.

Floodplain delineations are the province of the Water Division, Montana Department of Natural Resources and Conservation.

What is a 100-Year Flood?

A 100-year flood is one that can be expected to occur once every 100 years (one percent of the time), based on watershed records. However, just because a 100-year flood occurred last year does not mean that another 100-year flood couldn't occur next year. The likelihood is related to the magnitude of the flood, not the time that has passed between the 100-year flood events.

Photo: NRCS

Flooding is a natural process that occurs frequently in the Gallatin.

Information:
(including maps of delineated floodplains)

Gallatin County Floodplain Coordinator, Gallatin County Planning Office
582-3130

Bozeman Floodplain Administrator, Bozeman City Engineer
582-2380

Gallatin County Planning Office - Gallatin County Subdivision Regulations
582-3130

Bozeman Planning and Zoning Office - Bozeman Zoning Ordinance and Bozeman Area Subdivision Regulations
582-2360

Resources:

Flood insurance is available in Gallatin County through the NFIP. Contact your commercial insurance broker for more information.

Permitting:

Permits to build in designated floodplains or floodways must be obtained through the local Floodplain Administrator
582-3130; 582-2380

Photo: Pete Husby, NRCS

Wetlands provide homes for many species and provide water purification and retention benefits.

Wetlands

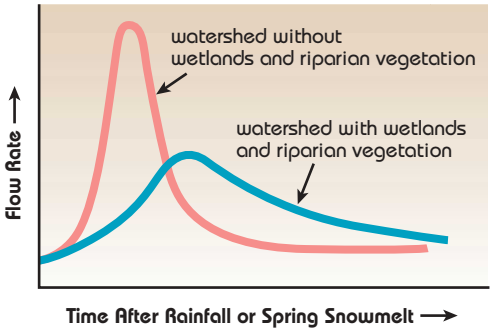
Wetlands are important components of any watershed. Wetlands typically act as a sponge—absorbing excess spring runoff and releasing it over time, thereby reducing peak flood flows. Wetlands provide passive water quality treatment benefits to our watershed community, such as trapping sediments, removing nutrients from agricultural runoff, and decomposing solids. Compared to the cost of man-made systems built to do the same work, the benefits provided by wetlands at no cost can be substantial. Wetlands assist in groundwater recharge. Wetlands also provide habitat for wildlife and plants, many of which are unique to wetlands. Nearly 60 percent of Montana's threatened and endangered species rely on wetlands to meet all or part of their seasonal needs. Historically, the benefits of the "ecological services" provided by wetlands was undervalued. As a result, many acres of wetlands have been filled or drained in the course of human activities, which has led to regulation to protect this valuable resource.

"Jurisdictional wetlands" (those wetlands that may receive some protection under federal law) have the following characteristics:

- source of water at or near the surface that occurs with a frequency and duration that supports life in saturated soil conditions;
- the presence of distinctive (hydric) soils, which are poorly drained;
- the presence of distinctive vegetation (hydrophytes) adapted to wet soils.

Certain activities affecting jurisdictional wetlands are regulated by federal, state and local governments. Section 404 of the federal Clean Water Act gives the Army Corps of Engineers authority to issue a permit for discharging dredge or fill material into wetlands or for draining wetlands. Most activities involving wetland disturbance require a permit, although some farming, ranching and logging activities less than three acres may be exempt under nationwide permits. Regardless of project size, if you contemplate activities that may affect a wetland or are unsure whether a wetland is involved, first contact NRCS or a professional trained in wetland regulation for further information. Gallatin County regulations prohibit subdivision within wetlands without prior Corps approval. "Swampbuster" provisions of the 1985 Food Security Act may also involve penalties when wetlands are altered to produce a commodity crop.

Effect of Wetlands on Streamflow



Source: Dunne and Leopold, Water in Environmental Planning

Destruction of wetland and riparian vegetation results in poor retention of water, resulting in higher peak flood flows and shorter duration of productive flows.

Wetland Web Sites:

National Wetlands Inventory:
http://www.nwi.fws.gov
http://www.wetlands.ca

EPA's wetlands site, WETNET:
http://www.epa.gov/owow/wetlands

Other Sites:

http//www.anca.gov.au/environm/wetlands/publicns.htm

http://www.biodiversity.environment.gov.au/environm/wetlands

Information:

MDEQ, Montana Wetlands Council
(406) 444-6652

USFWS, Regional Wetland Coordinator
(303) 236-2985

Montana Riparian and Wetland Association, School of Forestry, University of Montana, Missoula
(406) 243-2050

Montana Watercourse, MSU
994-6671

EPA Wetlands Hotline
(800) 832-7828

Resources:

USFWS, Partners for Wildlife Program (Private Lands Program) - funds projects that create, enhance or restore wetlands and provides technical assistance to private landowners
(406) 761-5450

NRCS, Wetlands Reserve Program - purchases conservation easements from landowners who agree to protect or restore wetlands
587-6929

Permitting:

U.S. Army Corps of Engineers, Helena - Section 404 permits
(406) 441-1375

NRCS - compliance with Swampbuster provisions
587-6929

Wildlife Habitat: Sharing a Home with Wildlife

From the blue herons seen winging their way between the Gallatin's streams in the late afternoon, to the bald eagles that seek the seclusion of the Valley's tall cottonwoods for nesting, many species find homes along the Gallatin's waters. The cover of vegetation growing next to streams is crucial for many animals as homes or as corridors for migration. While large tracts of public lands exist in the Gallatin, most of our native animals spend little or only a part of their lives in the forests that generally make up these public lands. In turn, most wildlife that live in the lowlands depend on habitats provided by water. The habitats that wildlife depend on can be degraded and literally lost forever by our land and water uses.

Photo: Brent Houston

Wetlands and riparian areas are important habitat for wildlife.

Riparian, floodplain and wetland habitats are all the more critical for species that are faring poorly, sometimes as a direct result of degradation or loss of these habitats. For example, most of the 13 species listed under the federal Endangered Species Act in Montana use rivers, wetlands or floodplains as habitat, as do several of the 8 species that are candidates for listing under the act in Montana. Neotropical migrants are songbirds like warblers, vireos, thrushes and some predatory birds. These birds nest in Montana but winter in the tropics. Of the 144 species classified as neotropical migrants in Montana, 88 percent use riparian areas for nesting or feeding. Some of these birds are declining in numbers, possibly as a result of habitat loss. Protection under the Endangered Species Act has been sought for the Yellowstone cutthroat trout and the Westside cutthroat trout, two Montana natives with surviving populations in the high-elevation streams of the Gallatin.

With so many species affected by changes to intact, functional riparian and wetland habitats, careful stewardship of these areas has never been more important. Over time, loss of vegetation due to development practices or fragmentation of vegetation patterns by the intrusion of development into wetlands, stream corridors and floodplains can affect how animals use these areas. Stream channel alterations, such as riprap, can affect fish populations. Cumulative residential development can restrict animal movement, breaking habitats into pieces too small to be of use for many animals. It also can interrupt cover, feeding, rearing young and migration. In turn, building in the riparian zone creates new conflicts with existing riparian residents such as deer, bear, moose, raccoon and beaver. These animals may regard expensive landscaping as simply an interesting meal. Ultimately, the conflicts result in fewer animals, a poorer environment and lower quality of life for both humans and animals.

You can improve your property's benefits for wildlife by:

- siting your home to avoid disturbing wildlife corridors, wetlands and riparian areas;
- controlling pets so they do not attract or disturb wildlife;
- maintaining and planting native vegetation and allowing riparian vegetation to recover;
- working with neighbors to create spaces for wildlife at the edges of your property;
- checking with your local Conservation District, NRCS, MFWP, or the USFWS before making any alterations to streams on your property.

Information:

Craighead, C. 1997. "Who Ate the Backyard? Living With Wildlife on Private Land." Grand Teton Natural History Association, Jackson, WY

Resources:

USFWS, Partners for Wildlife Program (Private Lands Program) - funds projects that create, enhance or restore wetlands and provides technical assistance to private landowners
(406) 761-5450

NRCS, Wildlife Habitat Incentives Program (WHIP) - provides technical, cost-share and education assistance for private landowners and wetland protection
587-6929

Ducks Unlimited - provides funds to state agencies to restore, enhance and create wetlands
(406) 458-5794

MFWP, Future Fisheries Improvement Program - funds stream corridor improvements, including fencing and bank stabilization; Water Leasing Program - authorizes MFWP to lease existing rights to improve streamflow (MCA 85-2-436); Habitat Montana Program - supports habitat acquisition, conservation easements funded through hunting and fishing license fees (MCA 87-1-241)
(406) 444-2449

The USFWS has information on endangered fish initiatives and other programs: http://www.r6.fws.gov

Whirling disease, caused by a tiny parasite, is devastating Montana's renowned fisheries. Currently, the Gallatin is free of disease. You can help prevent the spread of whirling disease to the Gallatin by:

- **Cleaning mud and aquatic plants from your gear and boat and draining water and drying your equipment between fishing trips.**
- **Never transporting fish from one body of water to another.**
- **Never disposing of fish parts or entrails in any body of water.**

CHAPTER 6 Watershed Recreation

–Mike Garcia, Northern Lights Trading Company

Importance of Water-based Recreation in the Gallatin

The Gallatin and its waters have probably provided places for people to fish, swim, boat and simply spend time alone or with family and friends since the earliest people inhabited this land. Later, paying guests were lured to the banks of the Gallatin at turn-of-the-century dude ranches like the Karst Camp. Today recreation services contribute significantly to the Gallatin's economy, employing over 500 persons at an annual payroll of 5 million dollars. Flyfishing guides, rafting outfitters, innkeepers and sporting goods dealers are just a few of those directly employed in providing recreational services in the Gallatin. Because the Gallatin's riparian areas are so attractive to wildlife, they are also important areas for hunting and wildlife watching. Like the benefits provided by the Gallatin's water for drinking and raising crops, the value of these services is incalculable.

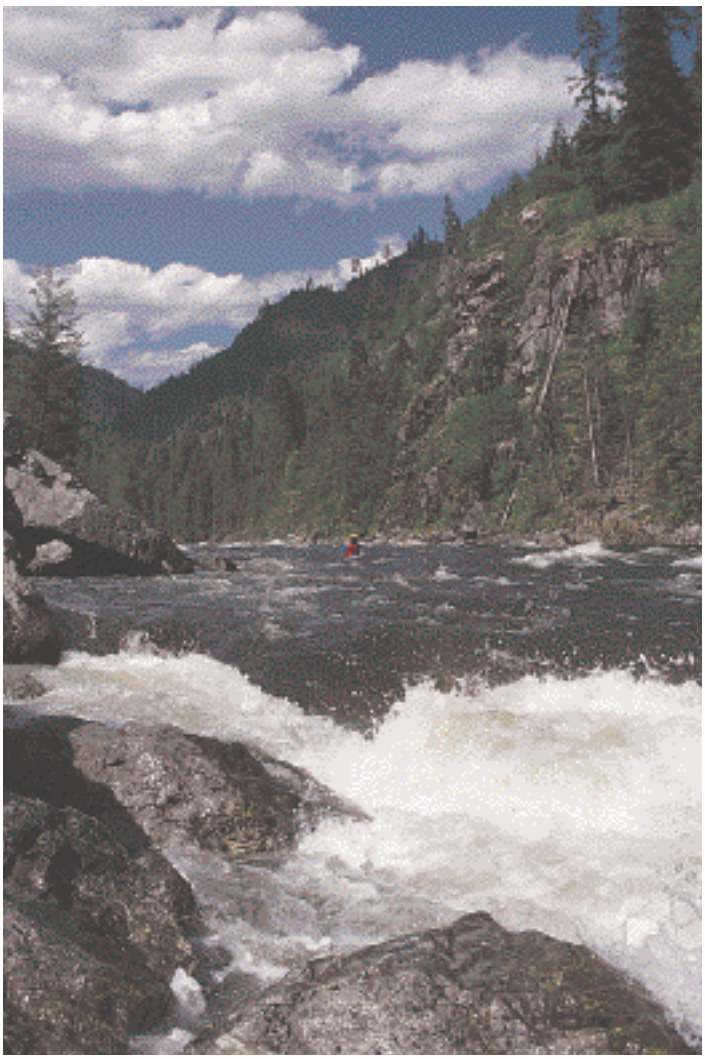


Photo: Mike Garcia

Recreation Demand and the Future of the Recreational Experience in the Gallatin

Demand for waters to provide recreation, as in most uses of the water resource, is rising (see charts). However, to paraphrase an old saying, "they're not making any new rivers." Conflicts among fishermen, boaters, developers and agriculturalists have always existed and will continue given this increasing demand. The dynamic among these groups as played out in the legislature and the courts has not only shaped the recreational experience on our streams but continues to be an important area for public involvement in charting the future health of our rivers. For example, in the 1960s and early 70s recreational traffic on our rivers was small, while at the same time our rivers were being quietly used to dispose of many pollutants. As recreational use grew, so did a heightened awareness by a greater number of people of the quality of our water resources. Development of a greater appreciation for these resources by recreational users led to efforts for greater conservation and cleaner water. Though the waters have become cleaner as a result, the sustainable qualities of the riparian environment have declined over that same time. Now, regulation of our rivers and streams to manage recreational use may be necessary so as not to "love them to death" or allow them to become little more than suburban parks. While previous efforts to conserve waterways focused on federal legal protection, state

Photo: Mike Garcia

and local governments now need to take a more active role in defining the future management of their riparian resources. While there will always be water to recreate around, the quality of that experience will depend on how we manage our behavior and plan for future needs.

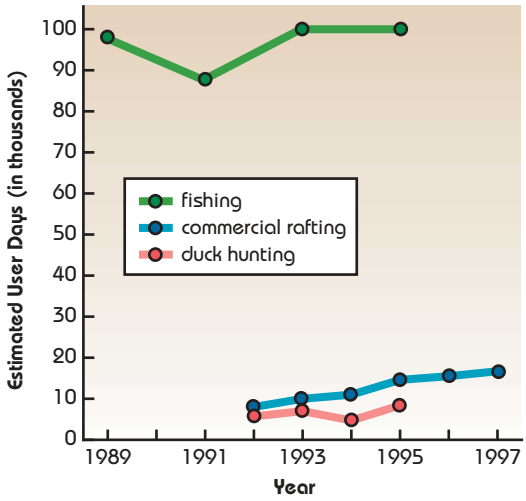
Recreating Responsibly

Responsible recreation around our waterways requires careful consideration of all your movements and monitoring your actions so as not to leave scars or pollute the water. The riparian is a unique environment that can be rejuvenated by yearly flooding, erasing evidence of casual human use. However, remember these are your waters. In the same way your house or car requires maintenance, waterways need to be maintained as well.

Riparian corridors are often confined spaces with high densities of human traffic, particularly in the Gallatin where there are few stretches of "wild" rivers. These simple courtesies will limit signs of abuse or thoughtlessness around river banks or the water's edge:

- **Garbage** - Leave no garbage of any kind. If you bump into someone else's garbage, pick it up.
- **Human waste** - In the event nature calls and no facilities are available, make sure you bury any human waste at least 6 inches below the soil, and make sure you hike at least 100 feet away from the river bank. Also, burn waste paper or carry it out in a closable plastic bag.
- **Camping/picnicking** - When choosing an area to spend some time in or around, purposely use a "high impact area," a spot that has been used or put aside for use. Leave unspoiled areas looking unspoiled. When it comes to fires, use an existing fire pan or fire ring, and leave a clean pit. Garbage collects around fire rings.

Water-based Recreational Use in the Gallatin Watershed



Sources: Gallatin National Forest, MFWP Reports

Montana's Stream Access Law

In general, the public is allowed recreational access to all river systems in Montana without regard to the ownership of the underlying land, up to the ordinary high-water mark (MCA 23-2-300 et seq.). This does not allow travel out of the water onto private land. While Montanans are entitled to use waters crossing private lands, it is in everyone's interest to obtain landowner permission first as a courtesy before using private lands, particularly on smaller streams.

Information:

Thompson, C. 1993. *Floating and Recreating on Montana Rivers*, Thomas Printing, Kalispell, MT

Resources:

USFWS, Fish Technology Center, 4050 Bridger Canyon Road - hosts an annual Fishing Derby for young anglers 587-9265

Many sporting goods stores offer classes on kayaking and canoeing

Bozeman Recreation Department - has classes and excursions 587-4724

Permitting:

Hunting and fishing require a license from MFWP; licenses are available at most sporting goods stores and at MFWP headquarters, 1400 S. 19th Avenue, Bozeman

Permits are not required to launch private watercraft in the Gallatin or East Gallatin Rivers. Boaters are not permitted to launch from private lands without permission

CHAPTER 7 Water Quality

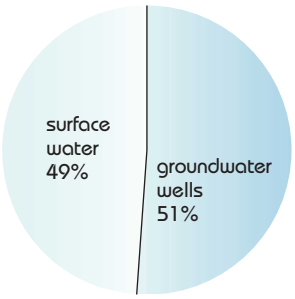
–Dave Whitson, Gallatin Local Water Quality District

Defining Water Use, Water Resources, and Responsibility for Water Quality

One common thread binding the Gallatin Watershed's community together is the universal need for a sustainable supply of clean water. Recent research has shown there is an intimate and dynamic connection between surface water and groundwater in the Gallatin Watershed. In many areas the rivers and tributary streams are directly linked to important groundwater aquifers. These aquifers exchange water readily and can be thought of as a "single, large glass of water that we all drink from using different lengths of straws." In essence we all live downstream of neighbors.

Virtually every type of urban or rural land use in Gallatin County has, through return of wastewater, some associated impact on the quality of our water resources.

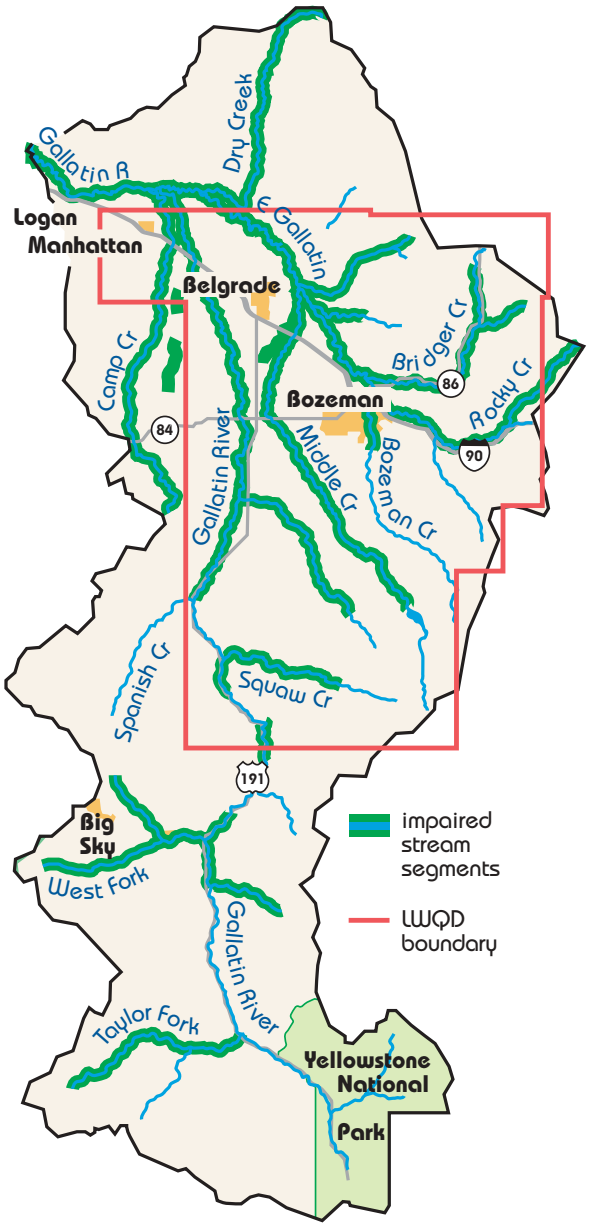
Sources of Water



Source: Gallatin LWQD

In 1996 about 51 percent of Gallatin County's population relied on groundwater as a source of drinking water.

Impaired Stream Segments in the Gallatin Watershed



Source: Gallatin LWQD; MDEQ, 1998. Waterbodies in Need of Total Maximum Daily Load Development (TMDL), Draft Document

Surface and Groundwater Water Quality in Gallatin County Today

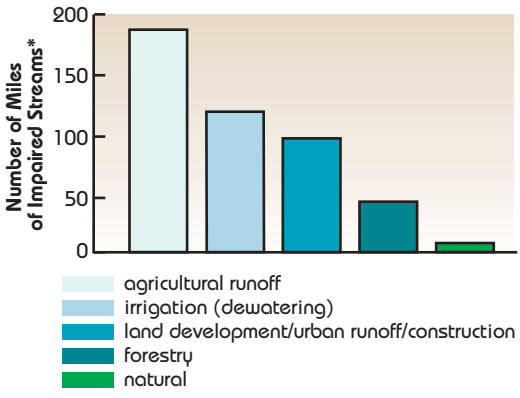
Surface Water

Overall, surface water quality in the watershed is good. However, 21 stream segments, totaling some 240 river miles, are classified by the MDEQ as "impaired" in the Gallatin River system. Impairments relate to surface water quality and/or availability, which may be due to single or combined land-uses along streams.

The leading contributors to stream impairment in the Gallatin Watershed are agricultural runoff and irrigation dewatering. This is not surprising, because the agriculture industry uses the highest percentage of land in the watershed. The third most significant cause of stream impairment is the combined effect from non-agricultural land development, urban runoff and road construction.

There are several other ways of looking at surface water quality. Some include examining physical contaminants, such as sediment or chemicals, in the context of whether water will support a set of intended "beneficial uses," which are defined by state water quality statutes (MCA 75-5-300 et seq.). The framework assuring water quality is complex and is embodied in the federal Clean Water Act, which serves as the model for Montana's Water Quality Act.

Most Common Sources of Surface Water Impairment in the Gallatin River Watershed



*Streams may be impaired by more than one source.

Sources: Adapted from MDEQ, 1998. Waterbodies in Need of Total Maximum Daily Load Development (TMDL), Draft Document

Groundwater

The most familiar way of thinking about groundwater quality is by comparison to some public health standard. This is done by comparing a water sample with federal and state drinking water standards for chemicals like organic compounds, gas or diesel fuel, pesticides, metals, nitrogen or coliform bacteria. Overall, groundwater quality in the Gallatin Watershed is good and is relatively free from regional impacts from harmful chemicals or contaminants.

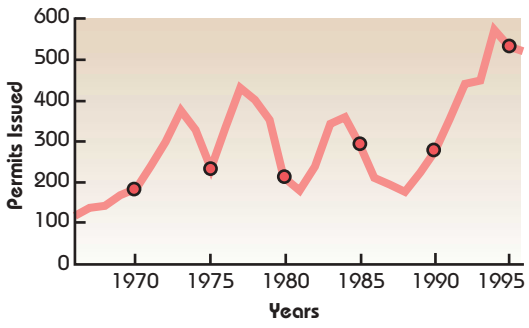
Regionally, groundwater in Gallatin County ranges from low to moderate in "total hardness" due to natural total dissolved solids and/or iron. Gallatin County's groundwater is classified as Class I to Class II (supporting use for drinking water and other domestic use according to Montana statutes), depending on the concentration of total dissolved solids (minerals) present. Total dissolved solids, which are related primarily to source aquifers of different character in the region, can affect taste of water, cause staining of household fixtures, odors, or other aesthetic nuisances. These seldom, if ever, warrant treatment and will not adversely affect your health.

Home water treatment using water softeners to remove these natural dissolved solids should be avoided if you have an on-site septic system. The by-products of home water softening can result in premature septic system failure and groundwater pollution or potential adverse health side effects.

Like other developed areas in Montana, Gallatin County has it's share of localized groundwater problems. Currently there are about 140 leaking underground fuel storage tanks and 5 Superfund sites in the county, which are in various stages of cleanup. More than 10,000 residential on-site septic systems are in use in rural and urban areas of the county. There are also many point and non-point sources for contaminants, such as nitrogen and coliform bacteria, which can adversely affect human health.

Most human-caused ground and surface water problems can be solved by prevention and use of best land-use and waste management practices and effective cleanup or elimination of existing pollution sources.

Annual Rates of New Septic Permits Approved in Gallatin County 1966-1996



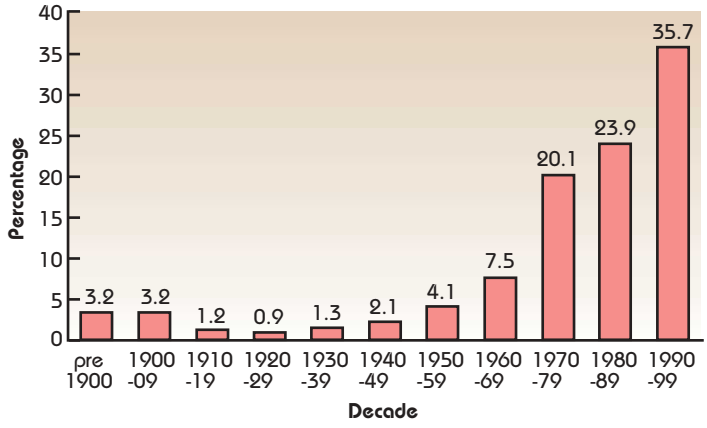
Source: Gallatin City-County Health Department

Changing Land Use and Groundwater Quality

It is estimated that Gallatin County's population in 2020 will be about 109,000 people. Challenges associated with growth and development arise as traditional rural farm and ranchlands are developed for other purposes. This rate of growth is mirrored in the number of new wells being drilled and new septic permits being permitted in rural areas of the county.

If we are to maintain a good, safe water supply into the future as urban centers and rural subdivision development expand, it is important to maintain adequate separation between incompatible land uses and developments.

Rate of New Wells Registered in Gallatin County



Source: Montana Bureau of Mines and Geology, Groundwater Information Center—Wells Database 7/96

Water Quality Web Sites:

Gallatin County:
http:/www.gallco.org/

Gallatin LWQD:
[coming soon]

Montana Water Center:
http://btc.montana.edu/watercenter

USGS Surface Water Information:
http://water.usgs.gov/public/realtime.html

EPA-State Water Quality:
http://www.epa.gov/OW/resources/states.html

Directory for Regional Organizations:
http:/eelink.umich.edu/GAIN/RM.dir/html.dir/toc.Organization.html

About the Gallatin Local Water Quality District (LWQD)

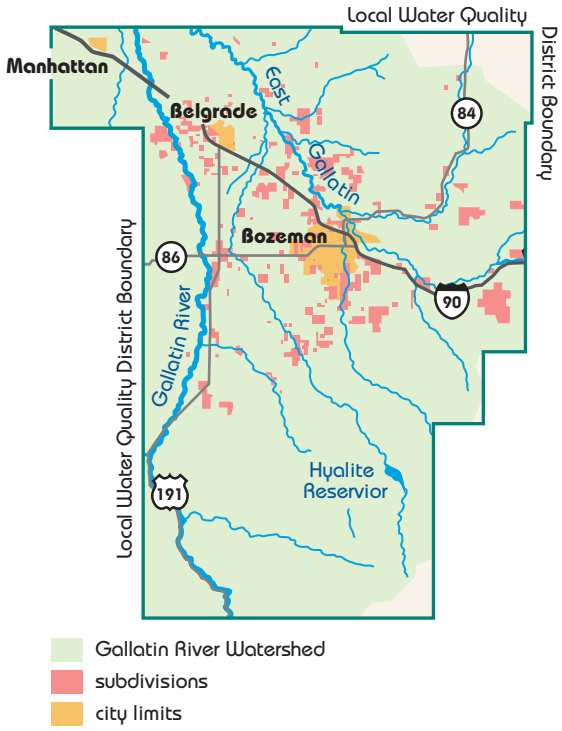
Rapid growth, combined with a growing number of individual private septic systems and private residential wells, has caused concerns about the possibility of surface and groundwater contamination and sustainability of the high quality of water resources in the Gallatin Valley.

The Gallatin LWQD is a non-regulatory agency created to provide water quality education. It also assists local citizens in design and voluntary implementation of methods for protecting, preserving and improving the quality of their local surface and groundwater resources, developing preventive measures needed to ensure a continued supply of clean water. Established in 1995, the Gallatin LWQD encompasses about 520,000 acres in north central Gallatin County. The district contains about 70 river miles of the Gallatin River system. Annually, about 60 percent of the surface water flowing through the district is derived from Gallatin River basin areas outside of the district.

The LWQD is presently developing and implementing water resource education, waste management, wellhead protection and water quality assessment programs. It has also initiated several programs to help Gallatin Valley residents understand, protect and improve their water supplies.

The LWQD is a proactive advocate of water pollution prevention at the source, rather than a reactive agency that responds only to problems after they develop. Ultimately, however, responsibility for the health, usability and future stewardship of both our surface and groundwater is dependent on the community as a whole. And that responsibility begins with each individual.

Residential Subdivisions in the Gallatin LWQD



Information:

State Programs

DNRC, Water Resources Division
586-3136

MDEQ, Surface Water Programs
(406) 444-5319

MDEQ
(406) 444-2544

Local Assistance Programs

Gallatin LWQD
582-3148

Gallatin City - County Environmental Health Department
582-3120

Gallatin County Extension - technical assistance for agricultural users (Farm*A*Syst)
582-3280

Montana Water Center
994-6690

NRCS
587-6929

State Farm Bureau
587-3153

Gallatin County Farm Bureau
587-9574

Resources:

MDEQ, State Drinking Water Revolving Fund - provides loans for construction of public health-related community infrastructure
(406) 444-5324

CHAPTER 8 Partners Protecting the Gallatin

Forging a Conservation Partnership

Protecting the Gallatin's water resources requires the interest of local citizens most affected by impacts on water quality and quantity and also beneficial governmental approaches to identifying and solving problems as they arise. The first soil and water conservation district in the Gallatin was formed in 1949. Soon after, the district requested that a Soil Conservation Service (now known as the Natural Resource Conservation Service-NRCS) office be opened and staffed to provide local landowners with technical assistance regarding soil and water erosion. Today the Gallatin Conservation District encompasses all portions of Gallatin County within the Gallatin Watershed, except for the 1949 city limits of Belgrade and Bozeman.

The Gallatin Conservation District is a unit of state government, dedicated to the wise use and protection of Gallatin County's soil and water resources. The Conservation District Board consists of five locally elected supervisors that volunteer their time to attend monthly meetings concerning local resource issues. The bulk of the district board's work is spent on administration of the Natural Streambed and Land Preservation Act (S.B. 310). The district accepts applications and issues permits ("310" permits) for activities below the normal high-water marks of streams and rivers in Gallatin County. The purpose of the permit is to minimize soil erosion and sedimentation, protect and preserve streams and rivers in their natural or existing state, and prevent damage to the lands and property immediately adjacent to streams and rivers.

The district teams up with the NRCS to provide technical assistance to private landowners to help solve natural resource problems. Together the cooperating agencies set goals, review requests for assistance, and coordinate with other resource agencies to implement programs and address problems. The district also sponsors conservation mini-grants for water quality, education activities, reclamation projects, energy saving and erosion repairs. In addition, it publishes a monthly newsletter with the Cooperative Extension Service and Farm Service Agency of the U.S. Department of Agriculture.

Photo: NRCS

Disturbance of any area near water may require special permits.

Case Study: Godfrey Creek

Godfrey Creek is a small stream in the western Gallatin Watershed in an area known as "Holstein Alley" for its numerous dairy farms. Once a source of clean water for the farms along its banks, by the mid-1980s Godfrey Creek's levels of fecal coliform (a bacteria found in animal waste), sediment, nitrogen and phosphorous exceeded state water quality levels. Most of the degradation was the result of livestock confinement practices and runoff from confinement areas and irrigation return flows. In 1990, 17 of the 27 farm operations along the creek joined with a number of federal and state agencies, including the USDA Consolidated Farm Service Agency, the NRCS, Gallatin Conservation District, MSU Extension Service, MDEQ, DNRC and the EPA to address water quality on the creek.

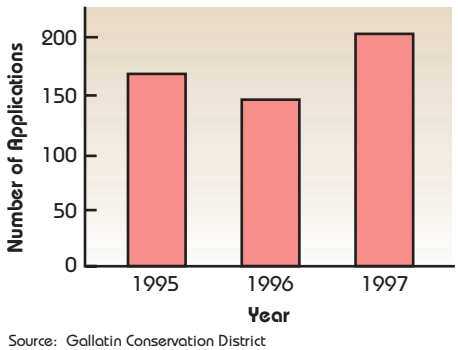
Producers participated in implementing best management practices to reduce non-point pollution. These practices include moving livestock watering facilities away from the creek, instituting better manure management, providing vegetative buffers between fields and corrals and the creek, and fencing. The changes were facilitated by a 75 percent cost share grant to the producers. Because the degradation of water quality in Godfrey Creek occurred over a period of many years, it will take time to restore the creek to its former quality. However, participants in the project have seen dramatic improvements. They believe they are benefiting not only the creek, but also the management of their farms. Godfrey Creek stands as an example of how groups of affected citizens can make use of community resources to successfully resolve local water quality problems.

Information:

Gallatin Conservation District 587-6929

MSU Extension Service-*Improving Water Quality at Godfrey Creek,* video 994-3273

310 Permit Applications



Source: Gallatin Conservation District

Stream modification projects continue to grow.

CHAPTER 9 Education and Citizen Involvement

"A river, though, has so many things to say that it is hard to know what it says to each of us."

–Norman Maclean, *A River Runs Through It*

Simple Ways to Involve Yourself

- **Call one of the organizations listed and ask how you can find out more about their projects and when they meet.**
- **Attend subdivision review and related planning and zoning hearings…most jurisdictions publish notice of meetings. Get involved in the planning stages and voice your opinions on development along streams and wetlands. The Gallatin County and Bozeman City-County Planning Boards meet the second and fourth Tuesdays of every month at 7:00 p.m.**
- **Write letters to city and county officials about your concerns.**
- **Attend Conservation District meetings.**
- **Vote.**

We are told that the quantity of the Earth's water is roughly unchanged from the time the earth was formed. As a chemical it is unique. A solvent of remarkable versatility, it is nonetheless one of the most stable compounds known. Repellent to most organic compounds, it binds tightly to metals, and most tightly to itself. Water pours through every crevice of our daily lives like, well, water! And while the importance of water to human life is paramount, we often assume that abundant supplies of clean water will always be available. This assumption is increasingly challenged by the reality of rising demands for supply (global water demand has tripled since 1950) and diversifying threats of pollution. Locally, it is the responsibility of each of us to do our part to ensure that we pass on the legacy of abundant, clean water to subsequent generations in our watershed and those downstream. Fortunately, many groups have organized in recent years to remind us of the values of our water and educate us about its role in shaping the landscape and the life dependent on it. Following are some local groups interested in water and issues in our watershed.

Educational Groups:

Bridger Outdoor Science School - provides summer programs for children, adult education and teacher training in natural sciences
582-0526

Gallatin Conservation District - public outreach and educational mini-grants
587-6929

Montana Watercourse - facilitates formation of local watershed education groups; develops water information seminars and field trips through "Know Your Watershed" forums; operates the Montana Volunteer Water Monitoring Project
994-6671

Project WET (Water Education for Teachers) - facilitates and promotes awareness of water resources through the development and dissemination of classroom-ready teaching aids and programs
994-6425

Photo: NRCS

Remember that storm drains carry water to streams with little or no treatment. Help spread the word about storm drain pollution prevention. Contact the Surfrider Foundation at 581-4379.

Montana Water Resources Center - supports water research; provides education and training for water professionals; promotes problem-solving partnerships among higher education, government and the private sector; and serves as a clearinghouse for Montana water information
994-6690

Montana State University Extension Service - extension specialists design and deliver water education curriculums and conduct applied research, provide water publications and water education programs, including the Montana Pollution Prevention Program, Drinking Water and Septic System Programs and other information
994-3451

Gallatin County Extension Service - sponsors local 4-H programs, technical assistance to county residents, weed control and management, farm and home management
582-3280

Montana Rural Water Systems - provides technical assistance, education, training to operators of small water and wastewater systems
(406) 454-1151

Yellowstone Center for Mountain Environments - MSU-based center participates in basic research on ecosystem management, riparian impact and watershed assessment
994-5178

Whirling Disease Foundation - coordinates funding for scientific research on whirling disease
585-0860

Citizens Groups:

Alternative Energy Resources Organization - agriculture and water quality, planning
(406) 443-7272

American Rivers - river conservation
(202) 347-7550

American Wildlands - water quality and federal lands
586-8175

Bozeman Watershed Council - watershed planning group focusing on the Bozeman Creek watershed and water supply planning for Bozeman; CONTACT Rich Morse
586-1203

Corporation for the Northern Rockies - regional planning, riparian protection
(406) 222-0730

Ducks Unlimited - wildfowl habitat; local chapter CONTACT Art Barbich
587-4254

Federation of Flyfishers
585-7592

Gallatin Valley Land Trust - conservation easements, trails
587-8404

Greater Yellowstone Coalition - advocacy regarding land use planning and water quality and quantity
586-1593

League of Women Voters - legislation and policy; Local Chapter CONTACT Judy Mathre
587-8666

Madison/Gallatin Alliance - SW Chapter of the Montana Wilderness Association
582-8600

Montana Environmental Information Center - water quality and mining, water quality and land use regulation
(406) 443-2520

Montana Farm Bureau - agriculture
587-3153

Montana Farmers Union - agriculture
(406) 452-6406

Montana Land Reliance - conservation easements
(406) 443-7027

Montana Nature Conservancy - conservation easements
(406) 443-0303

Montana's TMDL Process

EPA requires MDEQ to classify surface waters as "impaired" if they fail to meet certain criteria for supporting beneficial uses. In 1997 the Montana legislature directed the MDEQ to begin efforts to set limits on the discharge of pollutants to these waters. The Total Maximum Daily Load (TMDL) Process is meant to provide an opportunity for local citizens to provide leadership in development of water quality plans to bring these waters up to the standards necessary to remove them from the impaired list. For more information see the MDEQ web site, http://deq.state.mt.us/

Montana River Action Network - advocates for stream flows and water quality; local chapter, CONTACT Robin Cunningham
(406) 763-4642

Montana Water Resources Association - dam safety, water planning, protection of water rights
(406) 458-6487

Montana Wildlife Federation - wildlife conservation
(406) 449-7604

Mountain Surf Chapter - water pollution prevention; local chapter, Surfrider Foundation
581-4379

River Network - river conservation
(406) 442-4777

Sacajawea Audubon Society - wildlife conservation; local chapter,
CONTACT Valerie Harms
587-3356

Save Open Space - planning, watershed protection in Gallatin County;
CONTACT Terry Lonner
587-3583

Trout Unlimited - fish habitat; local chapter,
CONTACT Thomas Anacker
586-9111

Photo: Bobbi Geise

Local education programs have curricula designed to explore the world of water.

Learn more about education and information programs at the Montana Water Resources Center web site, http://btc.montana.edu/watercenter

CHAPTER 10 What It Means to Live in the Country

Information:

DNRC, Private Forestry Assistance Program - "Forest Stewardship and Water Quality Guidelines" (406) 542-4300

Gallatin County Weed Control District - Noxious Weed Management Plan, weed management information, identification guides, biological control options, Roadside "No Spray" program, rental program and cost sharing options 582-3265

Resources:

NRCS, Forestry Incentives Program (FIP) - provides funds for tree planting, timber stand improvements and other forestry practices 587-6811

MSU Extension Forestry, Missoula, Forest Stewardship Program (FSP) and Stewardship Incentive Program (SIP) - provides financial and technical assistance to landowners who wish to protect and enhance forest lands, wetlands and wildlife habitat (406) 243-2773

Gallatin County Weed Control District - chemical and biological cost-share programs for weed control 582-3265

Permits:

Burning - Bozeman Fire Dept. 582-2350

Fish stocking - MFWP (406) 444-2449

Forest harvest - Forestry Division, DNRC (406) 542-4300

Montanans are rightfully proud of their agricultural heritage. State and local governments are committed to ensuring the viability of farming and ranching in Montana and Gallatin County. While the land base in the county is still primarily agricultural, the number of people living in the unincorporated parts of the county doubled from 1965 to 1995, meaning that most people living in rural Gallatin County are relative newcomers. If you live near a farm or ranch, be aware that your proximity to farm and ranch operations requires special tolerance and additional obligations as a neighbor. Odors, dust, noise and slow-moving machinery are all facets of maintaining a robust agricultural economy in the Gallatin. Being a good neighbor means respecting the land and the people who share that land.

Irrigation practices in many parts of the valley have important seasonal effects on groundwater levels. Very high water tables and flooding during the peak irrigation season is entirely likely on adjacent property. While neighbors need to work together to resolve seasonal flooding caused by irrigation, recognizing adjacent property irrigation practices is an important first step in any development plan for your property.

Other obligations to keep in mind as a rural landowner include:

Fences - Montana is an open range state. Adjacent landowners are equally responsible for maintaining fences between them. As a general rule, fence your property to keep range animals out and your animals in.

Pets - It is unlawful for dogs and other pets to harass, kill or wound cattle, horses, sheep and other livestock.

Burning - Open burning is permitted in the county only between March 1 and October 31. Permits are $5 until May 1, $10 thereafter, and are good for the season. Permits can be obtained from the Bozeman or Belgrade fire departments. Permits are activated by calling a number listed on the permit.

Stockwater development - Although livestock are permitted casual use of natural streams that pass through property, diversion of water, including ground water, requires a permit from DNRC.

Fishponds - A permit is required from MFWP before you stock any species of fish in a private pond. Stocking of fish purchased out of state is prohibited.

Forest practices - Seven forest practices are prohibited within 50 feet of any stream, lake or body of water: 1) broadcast burning, 2) operating wheeled or tracked vehicles except on established roads, 3) clear-cutting, 4) constructing roads except when necessary to cross a stream or wetland, 5) handling, storing, applying or disposing of hazardous materials in a way that may pollute streams or cause damage or injury to animals or plants, 6) casting road material into a stream or wetland, or 7) disposing of slash in streams. A hazard reduction agreement is required before harvesting any timber. Contact DNRC for further information. Residential construction located in Gallatin County in the "Wildland Interface" (bordering undeveloped forest land) may require structural modifications, such as fire resistant roofing or installation of fire sprinkling systems, before approval from local fire districts to subdivide is obtained. Check with your local Fire Service Area or Fire Service District before subdividing or building.

Photo: Gallatin County Weed Control District

Weeds like spotted knapweed pose a threat to wildlife, livestock and native vegetation.

Noxious weeds - Property owners in Gallatin County are required by state law to control noxious weeds that occur on their property (MCA 7-22-2116). Gallatin County has a noxious weed management plan that identifies some 25 weeds in the county that warrant control and management. Accepted methods of weed control include biological control, mowing, handpulling, herbicide spraying in compliance with the most restricted herbicide label being used, fencing and peripheral treatment of border areas. Landowners contemplating activities that will disturb the land (such as roadbuilding) are reminded that a Noxious Weed Management and Revegetation Plan may be required from the Gallatin County Weed Control Board. Gallatin County also offers a Roadside "No Spray" Program. Contact the District for more information.

CHAPTER 11 Handling Household Hazardous Waste

Most people have products around their homes that, if used or disposed of improperly, have the potential to harm the Gallatin. Products that contain ingredients like "petroleum distillates," "trichlorobenzene," "lye" and "phenols" can cause particular problems in aquatic systems if they are not used and disposed of properly. While sometimes there are no less toxic alternatives for the job, you can improve the chances that these products will not harm the Gallatin by:

- **Purchasing only the amount of the product you need to do the job.** If you buy more than you need, products will tend to accumulate, adding storage problems around the home to your list of concerns.
- **Looking for alternatives to the product.** Often, non-toxic or less toxic alternatives are available. A metal snake can replace drain cleaner, for example. Some products contain less toxic components than others. Several Bozeman businesses specialize in "biological control" agents that take the place of some pesticides.
- **Following label instructions.** Most manufacturers are explicit about when, where and how to use their product, and how to store it and dispose of it. If these instructions are followed to the letter, the product should pose no threat to the environment.

Recycling

You can limit the amount of material that goes into landfills and thereby help extend the life of these potential sources of pollution by recycling. Several area businesses take recycling products and many companies supplying home offices will recycle material such as toner cartridges.

Disposal

Hazardous products should not be dumped in the trash. Area landfills require dumpers to certify that the materials brought to the landfill are not hazardous. It is best if you can actually use up the product. Even then, some containers of hazardous material require special disposal. It is never appropriate to dump or burn hazardous materials on your property, or dispose of products down storm drains. Most people forget that the storm drain system eventually flows straight back into our rivers.

Motor oil - Never dispose of oil down the storm drain. One quart of oil can contaminate up to two million gallons of drinking water. Used motor oil can be recycled through area gas stations for a fee or at the Bozeman City Shops on most weekdays.

Pesticides - Use up old pesticides according to label directions. You can rinse out the container and spray the rinsed water on the area the product was intended for before disposing of the container.

Antifreeze - Antifreeze contains ethylene glycol and is poisonous to fish, wildlife, pets and people. Pets are attracted to its sweet taste. Soak up any spills with kitty litter or absorbent and then sweep up and discard. Flood the area with large amounts of water to dilute any residues that might remain. Dispose of old antifreeze only at a service station that accepts this product or at a qualified dumping station.

Paint - Over 50% of the hazardous material disposed of by homeowners is paint (latex and oil-based paint, solvents and stains). Begin by purchasing only what you need. Consider sharing leftover paint with others, or finding appropriate uses around your home. While some water-based (latex) paints can be effectively neutralized by drying the remaining paint in the can, oil-based paints and solvents need to be disposed of as hazardous materials.

If you have hazardous materials, you may need to contact a regional disposal company that is permitted and specializes in disposal of these materials. Contact the MSU Extension Service for more information.

What to Do in Case of a Spill

Generally, never hose down a leak or spill. This will simply spread contamination. Use an absorbent material on the spill and dispose of the residue properly. If you have a spill that threatens to enter the stormwater system or any surface water, or in case of an emergency, call 911. Both the Belgrade and Bozeman Fire Departments have hazardous materials teams able to respond.

Information:

Montana State University Extension Service, Pollution Prevention Program - provides non-regulatory pollution prevention education and assistance to Montana small businesses and consumers, including: Home *A* Syst: An Environmental Risk-Assessment Guide for the Home; information circulars on alternatives to hazardous materials (Guide No. MT 9120 HR); identifying hazardous materials in your home (MT 9205 HR); disposal recommendations (MT 9207 HR); and disposing of motor oil and other automotive products (MT 9218 HR); educational curricula on the *Hazard-Free Home;* and videos 994-3451

Resources:

City of Bozeman, City Shops, 814 N. Bozeman - takes used motor oil 582-3200

Some Potentially Hazardous Household Materials

- **Automotive products: oil, battery acid, brake fluid, antifreeze, gasoline**
- **Fertilizers and pesticides: weed killer, fungicide, no-pest strips, rat poisons**
- **Household cleaners: spot removers, furniture polishes, deodorizers, drain cleaners, oven cleaners**
- **Maintenance products: latex and oil-based paints, mineral spirits, paint stripper, varnish, lacquer, wood preservatives, stains, asphalt, asbestos, roofing tar, swimming pool chemicals.**

CHAPTER 12 Your Septic System

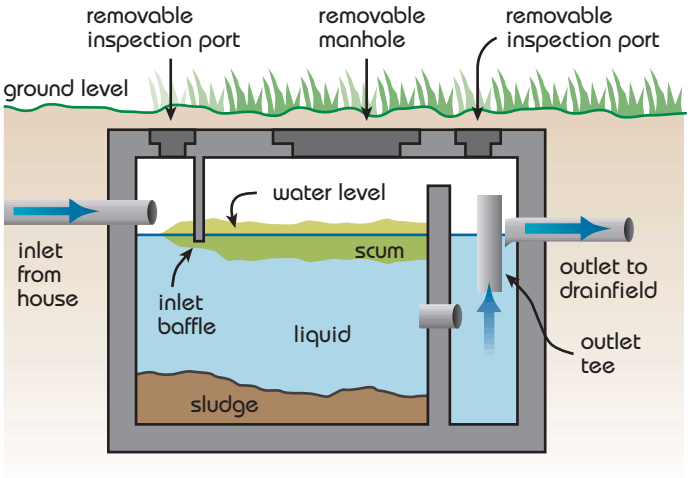
–Tim Roark, Gallatin County Department of Environmental Health

Septic systems are designed to break down and neutralize contaminants before they enter groundwater or surface water systems. A properly designed, installed and maintained system is an essential link in maintaining water quality in the Gallatin Watershed.

How Your System Works

The typical septic system consists of: 1) a septic tank, which separates, stores and begins to treat solid wastes, 2) a distribution system, which is generally a series of perforated drainpipes, and 3) a drain field, or soil absorption system. The soil absorption system receives effluent from the septic tank and filters and treats it by natural biochemical means before it enters the groundwater.

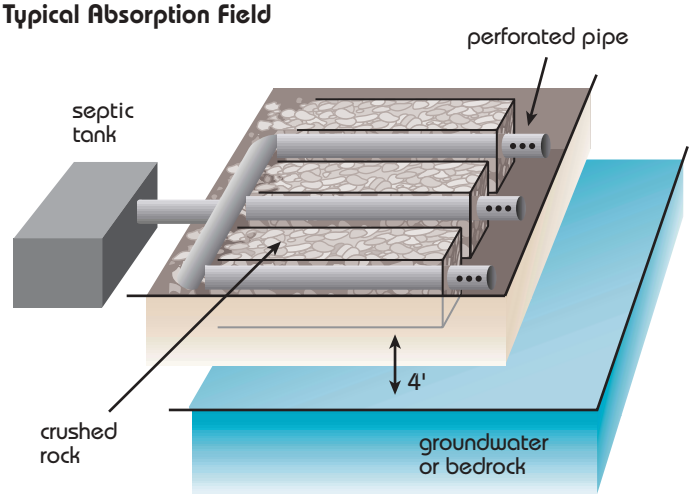
Parts of a Septic Tank



Siting Septic Systems/Permitting

Because of its dependence on natural filtering and treatment, soil is the most important part of a septic system. Chemical processes and naturally occurring microbes in soil break down contaminants, while pathogens eventually perish in the inhospitable environment. If soils are too wet (hydric soils), oxygen is not available for organisms that break down waste. Gravelly soils allow water to pass through to surface or groundwater too quickly, before breakdown of contaminants is complete. Clay soils may impede the rate at which water is filtered. In combination with household chemicals like water softeners, these soils can cause a system to fail. The Gallatin Watershed has many areas of both hydric and gravelly soils, meaning that septic system design is not a "one size fits all' proposition. The design of a system is based on soil and site characteristics, including depth to groundwater. Depending on where you live, soil and site characteristics may determine that a more sophisticated septic system is required. The design and sizing of any septic system in Gallatin County requires approval of the County Sanitarian. All septic systems are inspected to insure that they are properly installed. State and county regulations require that all soil absorption systems be located at least 100 feet from the 100-year flood plain and 100 feet from any surface water, as well as being located at least 100 feet from any existing well or spring.

Typical Absorption Field



Signs your septic system may be failing:

- Sewerage backup in drains or toilets
- Sluggish drains
- Mushy ground or greener grass around septic system
- Outdoor odors
- Nitrates or bacteria in your drinking water
- Algae blooms in ponds adjacent to your home

Common Causes of Septic System Failure

While many things can interfere with the operation of your septic system, by far the most important step you can take to prevent problems is to properly maintain your system. Your system requires two things to operate efficiently:

Proper bacterial action - the system is designed to accept normal household waste that contains the organisms necessary to promote digestion. Bacteria-killing products, like paint thinner, chemical drain cleaners, some water softening salts, paints, oils, acids and pesticides will destroy or inhibit the ability of your septic system to break down household waste.

Periodic pumping - sludge is the accumulation of solid material that cannot be further broken down by bacterial action and must be periodically pumped out. Failure to pump the system allows solids to overflow into the distribution system thereby clogging the drainfield. This not only can force a costly replacement of the system but may also result in sewage surfacing on the ground. While the frequency of pumping depends on the use of the system, the frequency of garbage disposal use, and the number of people using the system, generally a standard tank of 1,000 gallon capacity used by a family of four people should be pumped about every three years. Additives should not be added to your system to dissolve sludge. Several commercial septic pumping businesses operate in Gallatin County.

Septic system failure can also result from:

- Overloading. Avoid putting too much water into the system at one time; wash clothes at off-peak times, for example, rather than when the shower or sinks are being used.
- Pouring decay-resistant materials into the system. Grease, sanitary napkins and other solids will fill the tank faster than expected.
- Tree roots. Roots can clog or destroy the absorption system.
- Compacting soil over the drainfield. Driving vehicles over the drainfield should be avoided.
- Age of the system. Septic systems are designed for an operational life of 20 to 30 years. If you have an aging system, it may be time to inspect and replace your system.

Knowing When to Pump Your Tank

If you are unsure whether you need to pump, locate your access or inspection ports and determine the following:

- **Scum is less than 3 inches from the bottom of the baffle or top of outlet tee.**
- **Sludge is less than 12 inches from the bottom of the outlet tee.**
- **If the sludge and scum together take up more than half of the tank.**

Information:

MSU Extension Service - septic system guides; Montguides 9401, 9403 994-3451

MDEQ - design standards for septic systems, circular WQB (406) 444-4969

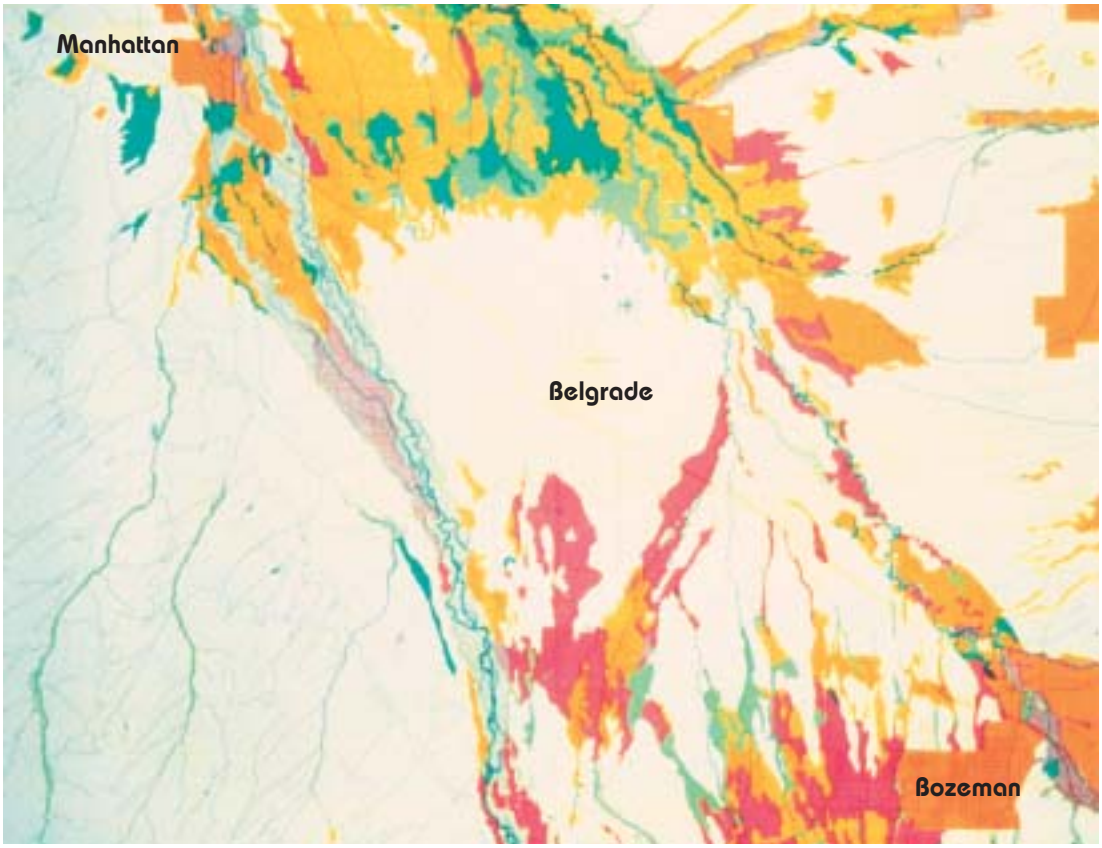
Resources:

NRCS - soil maps 587-6988

Permitting:

Gallatin City - County Department of Health - septic permits 582-3120

MDEQ (406) 444-4969



Source: NRCS

Colored areas show general soil types in the valley that may have some limitations for septic due to higher water. The county sanitarian determines the appropriate system for your soil type after more detailed site analysis.

CHAPTER 13 Protecting Your Well from Contamination

–Dave Whitson, Gallatin Local Water Quality District

Groundwater, like surface water, is not always safe to drink. It can be contaminated by naturally occurring chemicals and metals; discharges of human-derived industrial or agricultural chemicals; nutrients such as nitrogen and coliform bacteria from animal wastes or septic systems; and household-use fertilizers, pesticides and other hazardous chemicals. Well contamination can result by percolation of chemicals through the soil near the well. Or chemicals can enter groundwater directly through unsealed pipes and poorly constructed or improperly abandoned wells.

The key to protecting your well from contamination is prevention. Trying to clean up a well after it has become contaminated is inconvenient and costly.

Wellhead Protection: A Proactive Approach

Wellhead protection is a fundamental strategy for protecting your groundwater. Wellhead protection means keeping potential sources of pollution away from the source of your water.

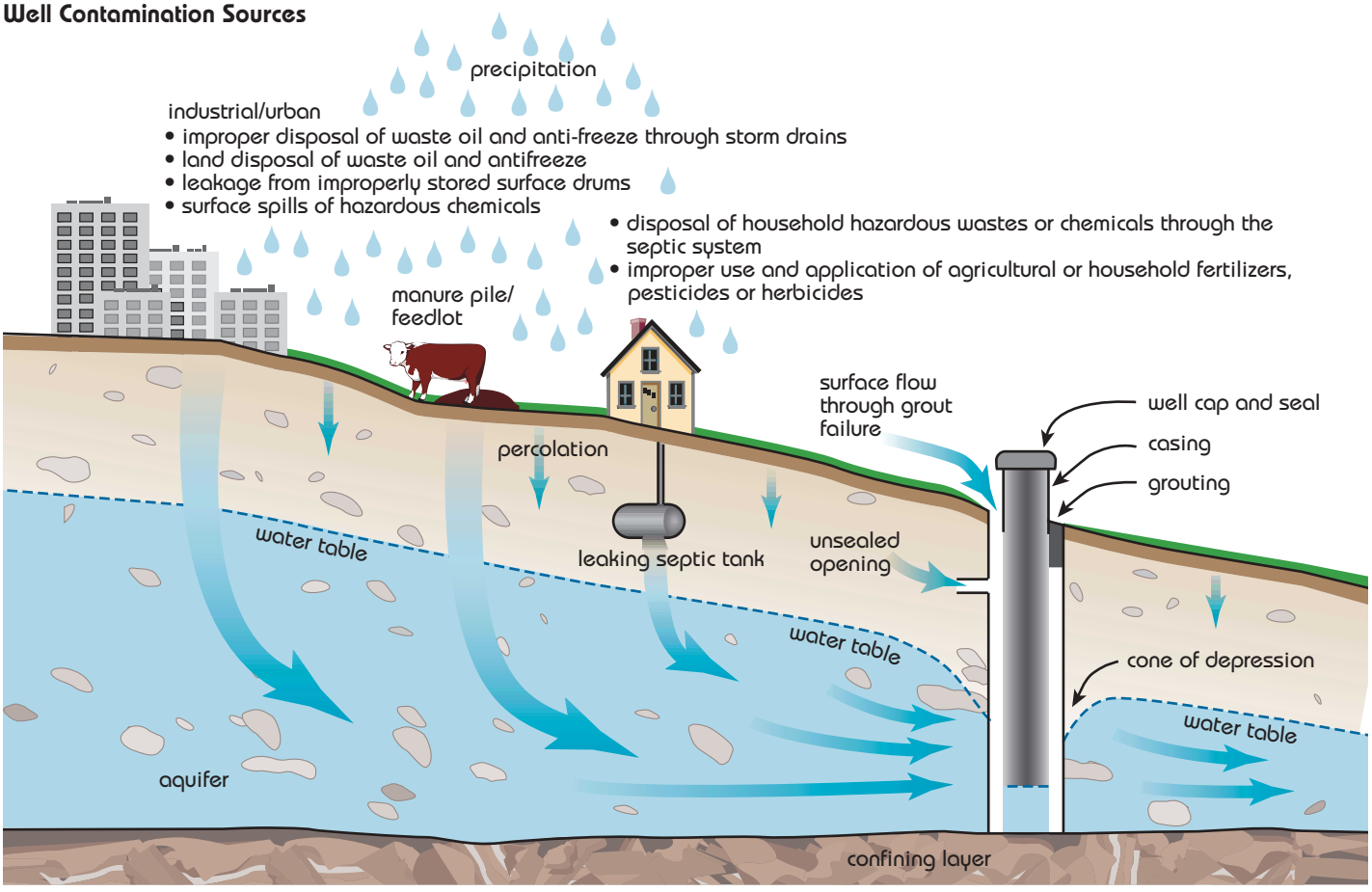
This is done by proper site selection for your new well, or if you have an existing well, using common sense to manage land uses near the wellhead, maintaining your well and on-site septic system, minimizing chemical use and eliminating storage of chemicals near your well, and reducing or eliminating hazardous chemical discharges to the ground or water in the vicinity of your well.

If you are planning to drill a new well, choosing the best location, away from potential sources of contamination, is important to protecting your water source. In choosing the best well site, the following factors should be considered.

Siting Your Well

- Montana law requires that wells be located at least 100 feet from any septic drain field, including your neighbors'.

Well Contamination Sources



- In most subdivisions in Gallatin County, well and septic drainfield locations on individual lots were designated as a condition of final subdivision plat approval. Before you build or drill, you should review the final subdivision plat on file at the Gallatin County Courthouse to determine the recommended well site. You also need to find out if minimum well depth requirements apply where neighboring septic drainfields are located.
- Avoid placing your well downhill or within 100 feet from a livestock pen or barnyard, fuel tank or storage area for hazardous chemicals. If you plan to board large livestock or numerous smaller livestock on your property, locate the barn and corral at least 100 feet away from your well.
- Shallow wells are more likely to be affected by contaminants than deeper wells. Generally, the deeper the well is, the less susceptible it will be to contamination if properly constructed and maintained.
- Wells must also be located a minimum of 100 feet from surface water bodies. It is also recommended that this 100 foot setback be applied near irrigation canals.

Remember, the greater the distance you can put between your well and potential contamination the better. The Gallatin Local Water Quality District, DNRC, local well drillers or groundwater professionals can assist you with selecting an appropriate well site.

Constructing Your Well

- Employ a Montana licensed well driller. Also, consult with the DNRC on current standards for water well construction and insure that proper compliance with those standards is maintained during well drilling.
- The well casing should be constructed to extend at least 18 inches above the natural ground surface or at least 2 feet above the maximum 100-year flood level, whichever is greater. All wells should be fitted with a watertight well cap upon completion.
- Wells designed to withdraw more than 35 gallons/minute, or greater than 10 acre-feet of water per year, require a water right permit from DNRC before construction.

Maintaining Your Well

- Periodically, do a visual inspection of the surface well casing and well cap for cracks. Any holes or cracks found should be repaired immediately to prevent entry of dirt, surface water and insects or other sources of contamination.
- Some older wells are connected to household plumbing systems or livestock watering areas without backflow regulators. Backflow prevention devices should be installed to prevent this. Backflow can also occur through hoses connected to well hydrants. Whenever filling an outside water container or chemical mixing tank, always maintain an air gap between the mixing tank and the fill hose. Failure to do so can result in backsiphoning to the well and direct contamination of your drinking water.
- Nearby septic systems should be correctly operated and maintained as recommended in Chapter 12.
- Chemicals, pesticides and oil or fuel products should not be stored, mixed, or spilled near the well.
- All unused wells should be properly abandoned in accordance with state standards. A well professional or the DNRC should be contacted regarding proper methods to close unused wells.

The land-use and waste-disposal practices near your well can have a profound affect on your water quality.

If you have an existing well, options for protecting your water may be limited to controlling potential contamination sources nearby.

Testing Your Well

Periodic testing of your well water is important. It is the only way to determine if a water quality problem that may affect your health exists. Periodic testing is also the only way to determine if over time the quality of your water changes due to changes in nearby or on-site land use or development. Annual tests for nitrates and bacteria in all wells is recommended.

The Gallatin LWQD can help you assess potential water quality problems, provide help and information on collecting water samples, and assist you in determining your wellhead protection needs.

Information:

DNRC, Water Resources Division
586-3136

MDEQ, Surface Water Programs
(406) 444-5319

MDEQ
(406) 444-4969

Gallatin Local Water Quality District
582-3148

Gallatin City-County Environmental Health Department
582-3120

Gallatin County Extension Service - technical assistance for agricultural users (Farm*A*Syst and Home*A*Syst Programs)
582-3280

Montana State University Extension Service - *Household Drinking Water Protection and Treatment*, EB 102; educational programs and videos
994-3451

CHAPTER 14

Best Management Practices for Lawns and Pastures

As an owner or resident of property adjacent to a stream or river, you are responsible for preventing livestock manure, pesticides, sediment and other pollutants from reaching waterways. A variety of established practices (known as Best Management Practices, or BMPs) are available to manage riparian areas to promote stream health and maintain water quality.

Managing Runoff from Homesites and Fields

One of the most effective ways of maintaining water quality in the Gallatin's waterways is putting space between human activities and surface water in streams and wetlands. Maintaining healthy riparian vegetation is the most effective way to trap sediment and pollution before it enters surface waters. Vegetative cover also provides erosion control and flood management benefits, as well as affording habitat for fish and wildlife. Depending on where you live and the size of the waterway, you should consider providing a buffer of one or more of the following types:

Photo: NRCS

Overwatering can lead to erosion and sedimentation, a leading cause of impairment in the Gallatin Watershed.

Riparian forest buffers - NRCS recommends forest buffers (trees and/or shrubs) adjacent to streams, lakes, ponds, and wetlands. Riparian buffers are tailored to the type of channel and size of the active floodplain.

Filter strips - These are grass strips or other permanent vegetation at the edge of a cropped field or animal confinement area that are intended to catch sediment and runoff before it enters the stream.

If your property has lost its streamside vegetation due to historical uses, consider reestablishing riparian vegetation. NRCS has technical information on how large buffers ought to be and what plants will be most cost-effective to reestablish.

Irrigation

Knowing when and how long to irrigate your lawn or pasture can save both time and water and prevent erosion. Careful attention to plant species, soil moisture and soil type is necessary to ensure that you are irrigating properly. Pastures in the Gallatin Valley are often planted to introduced plant species to increase production. These pastures may need additional water and fertilizer to keep them productive. In general, you should irrigate when soil moisture drops to about 50 percent of its water-holding capacity in the top 3 feet of soil. You can tell it is time to irrigate if soil from the top 18 inches crumbles when you try to form it into a ball, does not stain your fingers when you squeeze it, and feels only slightly moist. Irrigate sandy soils for short periods (2-3 hours) at short intervals for a total of 1.4 inches every 6 days, and clay and loam soils for longer periods (9-12 hours) at longer intervals, about 3.1 inches every 12 days.

Photo: NRCS

Water gaps provide opportunities for riparian vegetation to recover.

Lawns in our area normally need about 1 inch of water a week in a single watering. More frequent watering may actually harm your lawn, because it will not develop a deep root system and will be more susceptible to fungus growth. Watering in the heat of the day or during windy periods should be avoided. Gardens and landscaping can often benefit from installation of water-conserving systems like drip irrigation.

Livestock Management

Livestock management or the lack of it can have a tremendous impact on the vitality of any riparian or wetland area on your property. It can have impacts on your neighbors downstream as well. You can use many practices to reduce livestock impacts on these areas by:

Developing non-riparian sources of water for livestock

Livestock damage riparian areas by browsing down plants holding the bank together and by breaking down the banks. Livestock confined in a stream corridor leaves manure in the stream, which can affect water quality downstream.

- Developing fountains and other sources of water away from streams will reduce the amount of time livestock spend in and near the stream.

Limiting duration of livestock use

Healthy pastures have more surfaces covered with grass, which not only prevents surface erosion into surface waters but also provides your animals with more forage. To maintain healthy pastures:

- Don't put animals out in the spring until your pasture grasses are 6 to 8 inches high.
- Rest a part of your property during the grazing season by subdividing your property into smaller distinct pastures that can be grazed intensively.
- Horses do not need to graze 24 hours a day; 4-6 hours a day will meet all of their nutritional needs. Horses can be held off pasture the rest of the day, and should be moved to new pasture when grasses are grazed down to 3 to 4 inches.
- Don't overstock. A 1,100-pound horse needs about 875 pounds of forage per month, and grasses need a regrowth period of a month or more during mid-summer. Too many animals can quickly deplete your pasture.

General Water Requirements for Livestock

The amount of water required to support an animal unit (AU - a mother and young is 1 animal unit) of livestock can be estimated by the following:

1 cow AU	= 55,000 gallons/year (0.17 acre feet/year)
1 horse AU	= 83,000 gallons/year
300 chickens	= 55,000 gallons/year
1 family (5 people)	= 325,851 gallons/year
half-acre lawn & garden	= 69,000 gallons/season

Allowing streambank vegetation to thrive

Keep streambank vegetation healthy by:

- Considering exclusion of livestock from riparian areas. You can prevent livestock from degrading willows, trees and other riparian vegetation by excluding them with fencing.
- Maintaining water gaps and gravel pad crossings. Where livestock need to cross the stream to access other pastures or where no other water is available, create water gaps. Ranch managers in the Gallatin have used construction fabric and a gravel pad to create crossing areas between gently sloping streambanks. Cattle use these crossings preferentially, which greatly reduces streambank trampling. Fencing of adjacent riparian areas can enhance use of water gaps.
- Planting willow cuttings. Planting willows and other shrubs to control erosion and reestablish fish and wildlife habitat can restore degraded riparian areas. Willows sprout from fresh cuttings with little difficulty and are a cost effective and efficient way to restore riparian vegetation to streams where it has been lost. Willow cuttings need to be planted in bare, disturbed banks without grass competition.

Pest Management

Improperly applied and stored pesticides can easily enter both surface and ground water. Insecticides are primarily organophosphates and carbamates that kill insects by damaging the central nervous system. They can kill fish and wildlife in the same way. Pyrethroids are synthetic versions of naturally occurring insecticides. While they have low toxic effects to mammals, they are highly toxic to fish. Herbicides generally work to interfere with photosynthesis or alter plant growth, but may also have unintended effects on fish and invertebrates. While many herbicides have short toxic lives, some are easily transported by runoff or groundwater, which could have devastating effects on nontarget plants in wet areas.

- Avoid spraying in wetlands and riparian areas.
- Avoid pesticide applications between 10 a.m. and 4 p.m. and/or when wind speeds are greater than 5 mph.
- Use buffer zones of unsprayed crops or vegetation to protect adjacent wetlands or riparian areas.
- Don't use pesticides near stream edges. Use appropriate pesticides near streams. For example, use pyrethroids in upland areas but avoid their use near streams.
- Use biological and mechanical control where possible in areas near wetlands and streams
- Follow label guidance explicitly.

How to Reduce Your Use of Pesticides

Cultural practices

- **Choose plants with known resistance to common problems.**
- **Consider common sense methods of dealing with pests: rotating crops like potatoes, cleaning up garden debris, hand-picking pests, using row covers or traps, or tolerating some level of damage.**

Biological controls

- **Include plants near your garden that favor natural enemies of garden pests.**

Marigolds will repel nematodes, for instance, and ladybugs are available locally commercially for control of aphids.

- **Many predators, parasites and pathogens of garden pests are available commercially. *Bacillus thuringiensis*, a naturally occurring pathogen, is available for the control of caterpillars.**

Low-toxicity pesticides

- **Insecticidal soap is potassium salt-based and controls aphids, red spider mites and mealy bugs.**
- **Pyrethrum is derived from the chrysanthemum plant and is effective against most insects–but do not use near streams.**

Xeriscaping: the Water-Efficient Landscape

Picking Appropriate Species

Xeriscaping means using plants adapted to the semiarid conditions found in south central Montana and caring for them in ways that require less water. Many gardeners and landscapers have found that using adapted plants not only results in healthier lawns and gardens that use less water but requires less management as well. Talk to your local nursery about plants that will not only complement your home but will also thrive without heavy doses of water.

Practical lawns

While turf grasses are important in reducing runoff and controlling erosion, lawns should not be larger than necessary to meet some special function. Maximum water conservation is achieved when lawns are irrigated separately from trees and shrubs. When water restrictions are in place, lawns may go dormant, but will recover.

Mulches

Mulches of bark, compost, sawdust and plant waste (straw, leaves and grass clippings) help reduce evaporation from the soil. Use mulches on gardens and around trees and shrubs.

Mowing

Cutting grasses too low increases water demand and causes roots to die or deteriorate. Bluegrasses and ryegrasses should be cut no lower than 2 to 2.5 inches, and fescues 2.5 to 3 inches. Removing more than one third of the blade in one cutting injures the root system.

Fertilizing

Over-fertilizing does not improve plant growth and can damage the roots of turf grasses and pasture grasses, as well as harm water quality. Nitrogen and phosphorus, components of fertilizer, are easily washed into ground and surface waters. Fertilizer washed into a wetland can literally choke it to death, because the increased nutrients will cause algae to flourish, depleting the oxygen needed by other organisms. Follow label instructions and request a soil test from NRCS to better ascertain your specific fertilizer needs.

Composting

You can extend the life of your septic system by limiting the amount of solid material that goes into your tank by composting organic waste.

Some Plants Adapted for Our Climate

Grasses for dryland lawns

- Sheep fescue "Covar" (bunchgrass)
- Tall fescue "Alta" (bunchgrass)
- Streambank wheatgrass "Sodar" (sod forming; playing fields)
- Western wheatgrass "Rosana" (sod forming; erosion control)
- Thickspike wheatgrass "Critana" (sod forming; playing fields)

Perennials

- Blanketflower
- Plains coreopsis
- Prairie smoke

Shrubs

- Mountain mahogany
- Red twig dogwood
- Lewis mock orange

Trees

- Water birch
- Green ash
- Ponderosa pine

Information:

Montana Native Plant Society - *Source Guide for Native Plants of Montana*, MNPS, Linda Iverson, Box 3733, Big Timber, MT 59011

DNRC - *Tips on Land & Water Management for Small Farms & Ranches in Montana*, and *Riparian Grazing Successes on Montana Ranches*
(406) 444-6667

NRCS - technical information on Riparian Buffers: Riparian Forest Buffers, Montana Technical Guide Code 391; recommendations for low maintenance turf grasses for Montana
587-6929

Alternative Energy Resources Organization - *Groundwater Protection for Farmers and Ranchers*
(406) 443-7272

Montana BLM, Montana Forest and Conservation Experiment Station - *Successful Strategies for Grazing Cattle in Riparian Zones*, Riparian Technical Bulletin No. 4, Jan. 1988
(406) 243-2050

MSU Extension Service - Circular 1280, *Landscape Trees and Shrubs*

Resources:

NRCS - assistance in designing an appropriate irrigation system for your property
587-6929

NRCS - classes in pasture management for horse owners
587-6929

The Gallatin County Weed Control District
582-3265

CHAPTER 15 Water Conservation

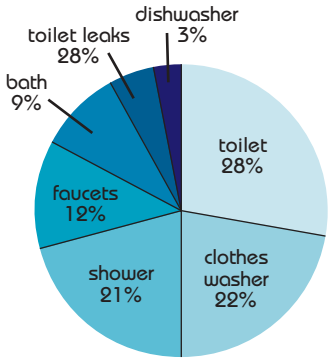
Using Water Efficiently

How we use water in our homes can have a tremendous impact on water resources. For example, 40% of indoor water usage goes to waste disposal through the toilet. A five-minute shower can use more than 40 gallons of water. Leakage through worn-out washers and faulty toilet tank valves accounts for up to 10% of all indoor residential water consumption. Conservatively, indoor leakage probably results in the loss of more than 200 million gallons of water per year in the Gallatin Watershed, enough water to supply 613 families for a year.

Most new home fixtures commercially available are low-flow fixtures. However, if you have an older home or are unsure, consider the following to eliminate waste and save both energy and money:

- install flow restrictors or low-flow showerheads;
- check faucets for drips;
- to detect toilet leaks, add a small amount of food coloring in the tank and watch for color in the bowl;
- reduce toilet tank volume by installing a water displacement device or a low-flow toilet;
- use an on/off nozzle to wash your car;
- wash only full loads in the dishwasher;
- avoid lawn watering when it is windy or during hot parts of the day.

Typical Water Use Around the Home



Source: Woodwell, 1995

Community-Based Conservation

Expanding water and wastewater infrastructure to meet the needs of growing communities in the Gallatin is not only costly but also ultimately means greater stress will be placed on our limited supplies of ground and surface water. The more communities and individuals do to use water wisely, the less demand will be placed on the water we have. Many communities around the country have faced this challenge. Some community-based solutions include:

Education

- Educating children and adults about water conservation, low-water-use demonstration gardens, landscaping assistance, pilot projects to test water conservation systems.

Financial incentives

- Providing free water audits similar to power company energy audits.
- Offering rebates for household and commercial remodeling that installs water-conserving fixtures.
- Rate restructuring to reward lower use rather than higher use.

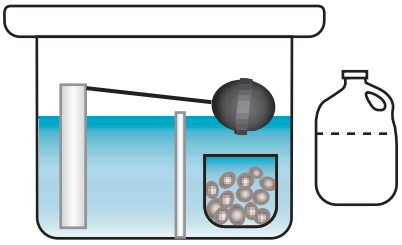
Local ordinances

- Requiring low-flow fixtures—the Big Sky Zoning District requires installation of low-flow fixtures in all new construction.
- Tax breaks for low-water-use landscaping.
- Allowing outdoor watering only during certain times.

Asking communities to join in this effort will require the efforts of citizens to move their leaders to create programs that the community will support.

Resources:

Montana State University Extension Service - agricultural drought guides, diagnostic wheels for water use around the home
994-3451.



Source: National Small Flows Clearinghouse

Reduce by 25 percent the amount of water flowing out of your toilet by placing a rock-filled plastic milk jug in your toilet tank.

Avoiding tomorrow's problems and conflicts depends on what we do today to maintain the high quality of water resources we enjoy. Water is a community resource that we all share. You can help protect the Gallatin's water in a variety of ways, including educating others, joining groups that protect water, employing more efficient practices around your lawn and pasture, better managing your septic system, or conserving water around the home. By taking action, you are entering a partnership with all of us who live in the Gallatin Watershed to safeguard this precious resource and ensure that the Gallatin remains a special place.

Additional Resources

Draft Critical Lands Element, Bozeman Area Master Plan. March, 1997. Bozeman City-County Planning Board, P.O. Box 640, Bozeman, MT 59771, 94 pp.

Byron, M. 1997. *A Guide to Montana Water Quality Regulation.* Legislative Environmental Policy Office, Environmental Quality Council, Helena, MT 59620.

Higgins, S. 1996. *Headwaters to a Continent: A Reference Guide to Montana's Water*. Montana Watercourse, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717, 64 pp.

Kendy, E. and R.E. Tresch. 1996. *Geographic, geologic, and hydrologic summaries of intermontane basins of the Northern Rocky Mountains, Montana*. U.S. Geological Survey Water Investigative Report 96-4025, pp. 73-82.

A Guide to Stream Permitting in Montana. 1993. Montana Association of Conservation Districts, 501 N. Sanders, Helena, MT 59601.

Montana Water Law. 1995. Montana Dept. of Natural Resources and Conservation, P.O. Box 201601, Helena, MT 59620-1601.

Who Does What with Montana's Water? A Directory, Third Edition. 1994. The Montana University System Water Resources Center and the Montana Watercourse, Montana State University, Bozeman, MT.

County Economic Profiles of the Greater Yellowstone Region. 1993. Greater Yellowstone Coalition, pp. 97-107.

Slagle, S.E. 1995. *Records of water levels in monitoring wells in the Gallatin Valley, Southwestern Montana*, 1947-93. U.S. Geological Survey Report 94-536, 41 pp.

Slagle, S.E. 1995. *Geohydrologic conditions and land use in the Gallatin Valley, Southwestern Montana*, 1992-93. U.S. Geological Survey Water Resources Investigative Dept. 95-4034.

Westesen, G.L. 1997. *Wading Into Montana Water Rights*. Legislative Environmental Policy Office, Environmental Quality Council, Helena, MT 59620.

Wolfe, M.E. 1996. *A Landowners Guide to Western Water Rights*. Roberts Rinehart Publishers, Boulder, CO.

Flood Plain Management Study: Gallatin River at Big Sky. 1996. USDA Natural Resources Conservation Service, Bozeman, MT.

Speakers Bureau

The following individuals or organizations are available to make presentations to your community organization or business group on the topics listed. Please contact the speakers listed below for more information.

Jim Bauder, MSU Extension Service. Topic: Voluntary monitoring, private well testing, large scale land practices, surface and groundwater quality 994-5685.

Craig Brawner, City of Bozeman Engineer. Topic: Water supplies, Bozeman municipal water 582-2380.

Doug Chandler, Allied Engineering, Inc. Topic: Water resources, water engineering applications 582-0221.

Scott Compton, DNRC. Topic: Water rights, groundwater information, state water projects, water well drilling regulations 586-3136.

John Etgen, Project WET. Topic: Water education, whirling disease 994-6425.

Phil Farnes, MSU. Topic: Snowpack, runoff, hydrology 587-8393.

Mike Garcia, Northern Lights Trading Company. Topic: River recreation 586-2225.

Bobbi Geise, Bridger Outdoor Science School. Community natural science education 582-0526.

Dennis Hengel, Gallatin County Weed District. Topic: Noxious Weeds 582-3280.

Sue Higgins, Whirling Disease Foundation. Topic: Work of the Whirling Disease Foundation 585-0860.

Kristi Hoffman, Montana Watercourse. Topics: Volunteer water monitoring 994-5398.

Judge Bruce Loble, Montana Water Court. Topic: Water rights 586-4364.

Donna Lovell, Wetlands West. Topic: Wetlands awareness 582-1992.

Jim Lovell, Confluence. Topic: Aquatic ecology, watersheds, flood hazard/mitigation, stream and river restoration 585-9500.

Judy McCarthy. Topic: Wetland sensitive plant species (honorarium) 587-3446.

Cliff Montagne, Assoc. Prof. Soils, MSU. Topic: Geology, soils, sediment sources, influences of land use 994-5079.

Michael Nicklin, Nicklin Earth and Water, Inc. Topic: Groundwater, environmental quality, contamination issues, Bozeman Solvent Site 582-0413.

Patti Rowland, Montana Water Court. Topic: Adjudication, water rights 586-4364.

Gretchen Rupp, MSU Extension Service. Topic: Drinking water, on-site wastewater management, water quality 994-1748

Betty Strook, Sweetwater Consulting. Topic: Hydrology, geochemistry 585-2806.

Gene Surber, MSU Extension Service. Topic: Agricultural water quality issues 994-5560.

Mike Vogel, MSU Extension Service. Topic: Household hazardous waste, water protection, environmental protection, education and citizen involvement 994-3451.

Wendy Williams, NRCS. Topic: Pasture management 587-6929.

Water Glossary

Aquifer: a sand, gravel or rock formation capable of storing or conveying water below the surface of the land.

Blue ribbon stream: one of 12 high quality trout streams in Montana designated by a Murphy instream flow designation.

Coliform bacteria: a group of bacteria predominantly inhabiting the intestines of man or animal but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms.

Cubic feet per second (cfs): a unit expressing rate of discharge, typically used in measuring stream flow. One cfs is equal to the discharge in a stream of a cross-section one foot wide and one foot deep, flowing with an average velocity of one foot per second.

Dewatered: natural flow of streams reduced due to withdrawals.

Erosivity: the capacity of a soil or land surface to be worn down or washed away by the action of water, ice or wind.

Floodplain: any normally dry land area that is susceptible to being inundated by water from any natural source.

Floodway: the channel of a river or stream and those parts of the adjacent floodplain adjoining the channel that are required to carry and discharge the base flood.

Groundwater: water in porous materials beneath the ground surface.

Hydric soil: a soil that, in its undrained condition, is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth of water-loving plants.

Hydrograph: a record showing the changes in flow of a river over time.

Instream flow: the water left in a stream to maintain the existing aquatic resources and associated wildlife and riparian habitat.

Irrigation return flow: irrigation water not consumed and returned to a surface or groundwater supply.

Murphy Right: special instream flow water rights recognized in 1969 when an instream flow protection bill was passed by the Montana legislature to protect the unappropriated waters of 12 high-priority trout streams.

Nonpoint source: entry of a pollutant into a water body from widespread or diffuse sources with no definite point of entry. The source is not a readily discernible point like a discharge pipe.

Ordinary high-water mark: the line that water impresses on land by covering it for sufficient periods to cause physical characteristics that distinguish the area below the line from the area above it.

Permeable: the capacity of porous rock, sediment or soil to transmit water.

Riparian areas: land areas adjacent to water that are identified by the presence of vegetation requiring large amounts of water, normally available from a high water table. Common riparian vegetation includes sedges, willows, alders and/or cottonwoods.

Siltation: particles of soil smaller than sand but larger than clay particles that are washed into streams and may impair biological and physical processes.

Snowpack: the winter accumulation of snow.

Transmissivity: the rate at which water passes through an aquifer.

Tributary: a stream that contributes its water to another stream or body of water.

Water budget: the accounting of the inflows and outflows of water to and from a system.

Water table: the upper level of a saturated zone in an aquifer below the soil surface.

Withdrawals: removing water from surface or groundwater sources in order to use it elsewhere.

Contributors and Acknowledgments

This Sourcebook is an outgrowth of a symposium held at the Museum of the Rockies in October, 1996, entitled "Know Your Watershed: The Gallatin." The workshop was presented under a unique partnership of local groups interested in public education and natural resources conservation, including the Bridger Outdoor Science School, the Montana Watercourse, the Gallatin Conservation District, the U.S. Natural Resources Conservation Service, the Forest Service, Montana State University, Montana Department of Natural Resources and Conservation, the Montana Water Court and other individuals. Presenters at the original conference included Judge Bruce Loble, Montana Water Court; Cliff Montagne, MSU; Phil Farnes, MSU; Doug Chandler, Geotechnical, Inc.; Betty Strook, Sweetwater Consulting; Scott Compton, DNRC; Gretchen Rupp, MSU Extension; Dennis Phillippi, Natural Resource Options; Buddy Drake, Drake & Associates; Craig Brawner, City of Bozeman; Bill Murdock, Big Sky Owners Association; Mike Garcia, Northern Lights Trading Company; Gene Surber, MSU Extension; and Andrew Marcus, MSU. The contributions of these individuals were instrumental in formulating the basis for this Sourcebook.

Developed by

Steve Forrest, lead author, Bridger Outdoor Science School

With Contributions by

Scott Compton, DNRC

Mike Garcia, Northern Lights Trading Company

Tim Roark, Gallatin County Department of Environmental Health

Dave Whitson, Gallatin Local Water Quality District

And Special Assistance from

Mary Ellen Wolfe, Montana Watercourse

Louise Forrest, Bridger Outdoor Science School

Wendy Williams, NRCS

Donna Lovell, Wetlands West

Phill Forbes, City of Bozeman

Curt Freese, Bridger Outdoor Science School

Gordy Hill, Gallatin Conservation District

Dale Beland, Gallatin County Planning Office

Mike Vogel, Montana State University Extension Service

Graphic Designer

Mary Myers, NRCS

Project Sponsors

Bridger Outdoor Science School

Bureau of Reclamation, Great Plains Region

Citizens to Save Open Space

Martha and Hobart Collins

Color World Printers

Gallatin Conservation District

Gallatin County Water Quality District

Gallatin County Weed and Pest Board

Gallatin Valley Land Trust

Lehrkind Distributing

Montana Community Foundation

Montana Fish, Wildlife and Parks

Montana Watercourse

U.S. EPA

USDA Natural Resources Conservation Service

Wetlands West

Edited by

Marcia Youngman

Printed by

Color World Printer, Bozeman, MT

The following individuals provided invaluable data or assistance:

Kimberly Shlenker, Gallatin National Forest; Dennis Flath, MFWP; Dennis Hengel, Gallatin County Weed Board; Henry Hathaway, Belgrade City Engineer; Ron Edwards, Big Sky Water and Sewer District; Bob McFarland, MDFWP; Candy Haskin, MDFWP; Pete Husby, NRCS; Sue Higgins, Whirling Disease Foundation; Tony Rolfes, NRCS.; Rachel Kyle, Montana Watercourse.

The Bridger Outdoor Science School is a tax exempt IRS 501(c)(3) scientific and educational organization located in Bozeman, Montana, dedicated to promoting an appreciation of the region's natural resources by providing quality environmental, conservation, natural resource, and outdoor science education to the public. P.O. Box 502, Bozeman, MT 59771, (406) 582-0526, boss@avicom.net.

The Montana Watercourse is a statewide adult and youth water education program at Montana State University, Bozeman. Its mission is to foster lifelong stewardship of Montana's water by providing adult and youth educational programs and materials for all water users. 201 Culbertson Hall, Montana State University, Bozeman, MT 59717, (406) 994-6671, zwc7001@montana.edu

The Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, provides technical assistance for the conservation, development, and productive use of soil, water and related resources. Federal Building, Room 443, 10 E. Babcock, Bozeman, MT 59715-4704, (406) 587-6811; Field Office, 3710 Fallon, Bozeman, MT 59718, (406) 587-6929.

Inset cover photo: James Healy; background cover photo: NRCS